2.0 ALTERNATIVES

2.1 INTRODUCTION

This section discusses the alternatives considered during the preparation of the DMMP, including those that were eliminated from further study, those considered in detail, and, for comparative purposes, the No-Action alternative. Also discussed is the approach that was used to develop the range of alternatives and to eliminate or refine them. All alternatives raised by the ICT, stakeholders, and the public were initially included. The next paragraph and sections 2.2 through 2.9 discuss the early process by which the ICT developed a matrix for scoring alternatives and the results of that process. Some of the information has changed from refined analysis and further investigations and this updated information is included, as necessary, in the sections after 2.9. However, the original data were left in sections 2.2 through 2.9 so that the reader can see the data that were available to the ICT in the matrix process. After much deliberation, the ICT ultimately determined that a PA by PA approach for dredged material management was necessary, which resulted in the DMMP included in Section 2.11.

The ICT decided to break the Laguna Madre into sections to facilitate the preparation and examination of the matrix analysis. It was felt that having one large matrix for all of the Laguna Madre would not allow the ICT to achieve any specificity in the DMMP. On the other hand, breaking the Laguna Madre into too many divisions would make the number of matrices so large that work on the DMMP would progress to slowly. Therefore, after much debate a compromise was reached to subdivide the Laguna Madre into six reaches. Supporting data, provided in Section 2.3 below, indicated that there were six relatively homogeneous regions into which the Laguna Madre could be conveniently subdivided and the ICT determined that six sets of matrices was a manageable number.

A matrix was developed which used a point system, or scores, for the impact of a particular placement option (e.g., offshore, upland, open bay, etc.) on particular impact receptors (e.g., threatened and endangered species, waterfowl and wading birds, benthos, terrestrial flora, ground water, hydrology, navigation hazards, etc.). Each receptor was evaluated objectively and independently by the ICT to achieve quantifiable and repeatable results. By combining the impact scores for the various scenarios on the receptors, the alternatives were ranked to produce a fully justified, numerically derived preferred alternative per reach, so that no alternative was excluded based on a single criterion, nor did any criterion dominate the ranking process. The development of the screening criteria, the alternatives matrix, the point systems, and the reasoning behind them are presented in detail below.

2.2 NO-ACTION ALTERNATIVE

The No-Action alternative is the base condition from which all other alternatives are compared. The purpose of this alternative is to forecast the most probable future of the study area, usually over the project's 50-year economic life without the project. For new projects, this alternative would forecast the future of the study area as if the project were not in place. However, the GIWW is an existing project that was authorized by Congress and constructed over 50 years ago. Therefore, the No-Action alternative represents the base condition with the GIWW in place and maintained by present dredging and placement methods. Furthermore, since it is an existing project, the baseline condition cannot be projected backward to the pre-GIWW period (prior to 1949). Another reason for not using a "without project" condition for no action is that it does not meet the underlying purpose and need of the NEPA assessment which is to update existing information and provide additional information and environmental analysis concerning dredged material placement from continued maintenance dredging of the GIWW through the Laguna Madre. Also, since the Section 216 study did not find a Federal interest in changing the dimensions, location, or terminating the project, the project does not need to go before Congress for reauthorization or deauthorization. Thus, the options remaining for consideration in this study are to resolve the environmental problems associated with present dredged material placement practices.

Based on these considerations, the forecast of future conditions with the project in place will provide the environmental baseline to compare all other alternatives for economic benefits and environmental impacts. The purpose of these comparisons is to clearly and accurately describe project-related economic and environmental benefits and costs so project decision-makers at all levels will be fully aware of the environmental consequences of their actions.

There was no Federal interest in abandoning or deauthorizing the GIWW since it is an important, safe, low-cost means of transporting goods along the Texas coast and it links the coastal ports with the vast national inland waterway network. The reach of the GIWW through the study area is an important link in the waterway that connects the upper Texas coast with its many petroleum-related, agricultural, and other manufacturing industries to the Rio Grande Valley. If this link were broken, about 2.25 million tons of commodities would be forced to find alternative means of transport (see Appendix H, Section 3.12.2.3, and Section 4.13 for more details on an alternative modes analysis).

2.3 DEVELOPMENT OF REACHES

It was recommended by the ICT that the effectiveness of the matrix analysis would be affected by how well the various impact receptors were described for each of the reaches. Therefore, the reaches needed to be defined such that the various impact receptors were fairly similar within a given reach without creating too many reaches. Although there were many factors to consider, the concern over the potential vulnerability of seagrass beds and benthic communities to dredging activities made them very important to the development of the reaches.

There are three obvious geographic breaks in the project area: the ULM, the LLM, and the Land Cut. The geography of many features corresponds to these breaks or varies (requiring further breakout) within each of the three. The ULM is generally shallower and sandier than the LLM (USACE, 1998; White et al., 1983, 1986, 1989). It is also more saline (Quammen and Onuf, 1993, White et al. 1983, 1986, 1989), which impacts several traits, including vegetation, benthic and nektonic communities (Sheridan, 1998, 1999; White et al., 1983, 1986, 1989). In general, the ULM is biologically less diverse than the LLM. The seagrass beds are predominantly shoalgrass in the ULM, while other SAV species are recognizable in the LLM (FWS and TPWD 1988–94). Benthic communities are less diverse in the ULM than in LLM, with the highest diversity in the southern part of LLM near Brazos Santiago Pass (EH&A,

1998b; White et al., 1986, 1989). Other characteristics that may indicate the need for separate reaches are water and sediment quality and tissue data that in a few locations have indicated causes for concern with respect to metals, excess nutrients and/or pesticides (DDT, chlordane). These areas are the Arroyo Colorado, Baffin Bay, Port Mansfield and Port Isabel (EH&A, 1997a; Davis et al., 1996; Barrera et al. 1995; Stockwell et al., 1993; Warshaw, 1975). Brown tide, when present, tends to be more prevalent in the ULM (DeYoe et al., 1997; Buskey et al., 1996; Barrera et al., 1995; Whitledge, 1993).

These data supported the division of reaches in the following way. First, the project area was broken into three major segments: the ULM and LLM and the Land Cut. The ULM was further divided into two reaches: 1) the northern end, which would be more affected by the proximity of Corpus Christi Bay; and 2) Baffin Bay and the southern end. This separates the deeper areas of the southern ULM (many too deep for seagrasses) from the broad shallow shelf to the north. It also separates the water quality concerns associated with Baffin Bay from the northern end where currents and proximity to the connection with the Gulf of Mexico increase circulation. This subdivision also roughly separates the areas where the GIWW is closer to the mainland in the southern part of the ULM from the section closer to the barrier island to the north.

The two ends of the LLM are very distinct. The northernmost section has higher salinity and supports less diverse benthic communities than the southern part (White et al., 1986, 1989). Also, much of the area that the GIWW traverses is in waters too deep to support seagrasses. The southernmost reach has lower salinities and is influenced by the Brazos Santiago Pass. It supports the most diverse benthic communities of the Laguna (White et al., 1983, 1986, 1989) and in this reach, the GIWW goes through some of the deeper parts of the Laguna and crosses a long stretch of unvegetated bay bottom. It is an area that requires a high frequency of maintenance dredging (Brown and Kraus, 1997).

There is reason for a third, intermediate reach within the LLM, associated with the Arroyo Colorado. The use of three subdivisions allows Port Mansfield, the Arroyo Colorado and the Port Isabel/South Padre Island areas, each with their own water quality issues, to be in separate reaches. The Arroyo Colorado is part of the central region. In this reach, the GIWW traverses shallower waters, in part, adjacent to the mainland and, in general, has finer-grained substrate than the other reaches. Also, the shoreline of the LANWA lies wholly within this one reach.

This analysis creates six reaches with lengths ranging from 11–25 miles. These are reasonable lengths for individual assessments. These divisions should allow adequate consideration of local characteristics and concerns without creating too many reaches, which would be less practical for both data compilation and analysis.

The following six reaches are designated for the project area (see Figure 1-1). Placement area numbers and Channel Stations are from the USACE (Table 2-1).

TABLE 2-1

REACHES

Reach	Reach Description	PA No.	Channel Station*	Statute Mile**	Length (miles)
1	John F. Kennedy Causeway (Corpus Christi) to northern side of Baffin Bay	175–191	27+000–126+900	553–572	19
2	Northern border of Baffin Bay to northern boundary of the Land Cut	192–202	126+900–216+165	572–588	16
3	Land Cut	203–210	216+165–327+739, 319+200–297+400	588–612	24
4	Southern boundary of the Land Cut to south of Port Mansfield	211–222	297+400–165+000	612–638	25
5	South of Port Mansfield to south of Arroyo Colorado Cutoff	223–228	165+000–105+000	638–649	11
6	South of Arroyo Colorado Cutoff to old Queen Isabella Causeway location (Port Isabel)	229–239	105+000–18+000	649–665	16

* Channel station numbers are from two series of numbers. In the ULM, numbers increase from north to south. In LLM, numbers increase from south to north.

** Statute miles were taken from NOAA Nautical Charts and are based on zero at Harvey Lock, LA.

The reaches were broken into smaller divisions, designated as segments, to prevent the distance from the dredge to various placement areas from exceeding 7 miles. There are several reasons for this division. This segmentation is considered a mechanically feasible distance for pumping. For example, the maximum pumping distance for beach nourishment at Galveston, along Seawall Boulevard, was roughly 7 miles. However, this pumping distance was achieved with a 34- to 36-inch dredge, and as can be determined from the following table (Table 2-2) of pumping distance versus dredge size, a 20- to 24-inch dredge, which is able to work the GIWW, cannot achieve this pumping distance without boosters. There are parts of the Laguna where the distance from the GIWW to the shoreline is roughly 4 miles. This allows only a 6-mile stretch of the GIWW (3 miles on either side of the point at which the pipeline goes toward shore) to be dredged per Upland Confined Placement Area. Therefore, a pumping distance shorter than 7 miles would require an inordinate number of upland placement areas.

Only a 24-inch dredge can achieve much production, even at 2 miles. Boosters are basically dredges without the suction head, but there is roughly a 10 percent loss of volume for each booster used, so stringing more and more boosters in series does not maintain production. In practice, even a series of a few boosters reduces production so much, while increasing plant cost, that it no longer is feasible.

TABLE 2-2

PRODUCTION RATE VERSUS PUMPING DISTANCE FOR VARIOUS DREDGE SIZES

Dredge Size (inches)	Pumping Distance (feet/miles)	Production Rate (cubic yards/hour)
20	4,520/0.9	800
	9,040/1.7	520
	12,995/2.5	220
22	4,500/0.9	1,000
	9,000/1.7	650
	13,000/2.5	280
24	5,650/1.1	1,200
	11,300/2.1	780
	15,820/3.0	330

2.4 EVALUATION CRITERIA/RECEPTORS

The approach recommended by the ICT involved the development of a matrix which 1) clearly presents the reasoning behind the numerical rankings and 2) clearly presents the advantages and disadvantages of each alternative to each impact receptor.

At an early meeting (September 1999), the ICT developed 22 evaluation criteria or receptors. At subsequent meetings, those 22 evaluation criteria were synthesized into eight Resource Categories, as shown in the following table (Tabie 2-3), but only six were analyzed since endangered and threatened species were included in the first eight, and cost was not a factor in the analysis.

TABLE 2-3

RESOURCE CATEGORIES

Resource Category	Original Evaluation Receptors
Submerged Aquatic Vegetation	Aquatic Flora
Open-Bay Bottom (excluding seagrass)	Benthos Beneficial Uses
Emergent Bay Habitat	Benthos Beneficial Uses Tidal Flats Waterfowl/Wading Birds Wetlands
Terrestrial Habitat	Beneficial Uses (sediment quality, location, recreational fisheries) Terrestrial Flora – Wetlands/Uplands Terrestrial Fauna

TABLE 2-3 (Concluded)

Resource Category	Original Evaluation Receptors
Water Column Effects	Nekton Plankton Water Quality – Turbidity/Toxicity Circulation
Human Use Effects	Air Quality/Noise Navigation Hazards Historical Resources Commercial/Recreational Fisheries
Endangered and Threatened Species	The impacts on E & T Species should be considered for all relevant criteria. For example, the impact to endangered sea turtle species is reflected in the scoring of the impact to their habitat, in this case, primarily seagrass beds.
Cost	Dredging/Placement Costs Reduce Frequency of Maintenance Time – ability to meet GIWW maintenance schedule

2.5 PLACEMENT ALTERNATIVES

At the same series of meetings noted in Section 2.4, the following placement alternatives were recommended by the ICT for further consideration:

1. Open Ocean/Offshore Placement
    a. Hopper Dredges
    b. Pipeline Dredges and Scows
    c. Pipeline Dredges and Pipelines
2. Upland Placement
    a. Confined Upland Placement
    b. Thin layer Placement
3. Beneficial Uses
    a. Beach Nourishment
    b. Washover Nourishment
4. Open-Bay Placement
    a. Open-Bay Unconfined
    b. Open-Bay Confined
    c. Open-Bay Semiconfined

2.6 SCREENING CRITERIA

The ICT recommended early in the evaluation process that, while the list of alternatives for each reach would include essentially all possibilities, it would be prudent to develop screening criteria and apply these first, rather than expend extensive resources and time investigating all alternatives, including those that were not feasible. These screening criteria provide a fatal flaw analysis, such that if any of the screening criteria were not met, the placement option would not be feasible and, therefore, would not be subject to evaluation. The screening criteria were three:

- Meet Engineering Feasibility – For example, a hopper dredge that was too tall to fit under the JFK Causeway could not be used for ocean placement of material from Reaches 1 through 4.
- Meet Federal Requirements – For example, pipelines across the PINS are not allowed by the NPS and, therefore, an alternative that required pipelines across the PINS would not meet the Federal Requirements Screening Criterion.
- Meet State Requirements – For example, if an alternative allowed the release of a discharge that violated TCEQ Water Quality Standards or if an alternative was not in compliance with the Texas Coastal Management Program, that alternative would not meet the State Requirements Screening Criterion.

Table 2-4 presents the application of the Screening Criteria to each Placement Option, by Reach.

Open ocean placement by hopper dredges did not meet the Engineering Feasibility Screening Criterion for any reach. This is because, as noted in Section 2.9.1.1, these dredges cannot turn around in the GIWW and the ICT did not consider it to be environmentally acceptable to allow dredging of numerous turnaround basins in the Laguna Madre. This alternative would require each hopper dredge to transit the length of the GIWW between each of the three entrance channels (Corpus Christi, Port Mansfield, and Brazos Island Harbor), depending on which reach was being dredged. Therefore, as an examination of Section 2.9.2.1 reveals, this option would require an average of 18.6 dredges in the GIWW between, and in, the Corpus Christi Ship Channel and the Port Mansfield Channel 24 hours per day at all times to remove the maintenance material. There would be an average of 3.1 dredges in the GIWW between the Brazos Island Harbor Channel and the Port Mansfield Channel and in the two ship channels 24 hours per day at all times. These two combined would yield a minimum of 21.2 dredge trips/day or 7,738 trips/year in the GIWW through the Laguna Madre, just to keep up with the sediment that accumulates in the GIWW. This assumes that needs for maintenance dredging in the various reaches could be accomplished using the fewest possible dredges and that this number of dredges could be located and made available. The latter assumption is not engineeringly feasible since that number of hopper dredges, of all sizes, is not available, and certainly not of the small size which could be used in the GIWW (USACE data). For example, Great Lakes Dredge and Dock Company, a major dredging firm, listed only seven trailing suction hopper dredges on their website (www.gldd.com in 1999), and none of these were as small as those used for the analysis in Section 2.9.2.1.

TABLE 2-4

APPLICATION OF SCREENING CRITERIA

		Placement Options									
		Upland		Open Ocean / Offshore			Beneficial Uses		Aquatic		
		Confined Upland	Thin Layer	Hopper Dredges	Cutterhead Suction Dredge and Scows	Cutterhead Suction Dredge and pipelines	Beach Nourishment	Washover Nourishment	Open Bay / Unconfined, existing PAs only	Confined	Semi-confined
REACH # 1									+		
Screening Criteria	Engineering Feasibility	Y	Y	N	N	Y	N	N	Y	Y	Y
	Meet Federal Requirements	Y	Y	Y	Y	N*	N*	N*	Y	Y	Y
	Meet State Requirements	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
REACH # 2									+		
Screening Criteria	Engineering Feasibility	Y	Y	N	N	N	N	N	Y	Y	Y
	Meet Federal Requirements	Y	Y	Y	Y	N	N	N	Y	Y	Y
	Meet State Requirements	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
REACH # 3		+									
Screening Criteria	Engineering Feasibility	Y	Y	N	N	N	Y	Y*	Y	Y	Y
	Meet Federal Requirements	Y	Y	Y	Y	N	N	N	Y	Y	Y
	Meet State Requirements	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
REACH # 4									+		
Screening Criteria	Engineering Feasibility	Y	Y	N	N	N	N	N	Y	Y	Y
	Meet Federal Requirements	Y	Y	Y	Y	N*	N*	N*	Y	Y	Y
	Meet State Requirements	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
REACH # 5									+		
Screening Criteria	Engineering Feasibility	Y	Y	N	N	Y	N	N	Y	Y	Y
	Meet Federal Requirements	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Meet State Requirements	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
REACH # 6									+		
Screening Criteria	Engineering Feasibility	Y	Y	N	N	Y	N	N	Y	Y	Y
	Meet Federal Requirements	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Meet State Requirements	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

N* Part of Reach encompasses the National Seashore, which no pipelines can cross.
Y* Not enough washover areas to handle all material
+ Present Practice for this Reach.

Open ocean placement by cutterhead suction dredges and hopper barges (scows) failed the Engineering Feasibility Screening Criterion for all reaches, again because of a lack of sufficient equipment. As noted in Section 2.9.2.2, during all available times, three dredges and 12 scows would be needed and during 42 percent of the time, an additional dredge and four scows would be needed. This leads to a total of 2,605 trips by hopper scows, plus tugboats (covering 155,383 miles per year), through the GIWW and associated entrance channels to the Gulf of Mexico. Section 2.9.2.2 also notes that there are presently only four scows available on the Gulf Coast. The Great Lakes Dredge and Dock Company's website (www.gldd.com) only listed a total of 31 scows and 14 tugboats in 1999, some of which are too big for the GIWW. However, even if all were of the correct size, dredging the GIWW through the Laguna Madre would consume over half of the scows and more than all of the tugs.

Open ocean placement by cutterhead suction dredges, pumping through pipelines to the Gulf of Mexico, failed the Engineering Feasibility Criterion for Reaches 2, 3, and 4 because pumping distances are so great that the required number of boosters would reduce the flow to zero at the end of the pipeline (Section 2.9.2.2). It also failed the Federal Requirement Criterion for all of Reaches 2 and 3 and parts of Reaches 1 and 4 because the pipeline to the Gulf would have to cross the PINS.

Beach nourishment failed the Engineering Feasibility Criterion for all reaches, except Reach 3, because the maintenance material contains insufficient sand to be used for beach nourishment. It also fails the Federal Requirement Criterion for all of Reaches 2 and 3 and parts of Reaches 1 and 4 because the pipeline to the Gulf beach would have to cross the PINS.

Washover nourishment failed the Engineering Feasibility Criterion for all reaches because the maintenance material contains insufficient sand to be used for washover nourishment. It only partially satisfies the Engineering Feasibility Criterion for Reach 3 since there is insufficient washover area in Reach 3 to use all of the dredged material. It also fails the Federal Requirement Criterion for all of Reaches 2 and 3 and parts of Reaches 1 and 4 because the pipeline to the washover areas would have to cross the PINS.

The two upland placement options (upland confined and upland thin layer), the three open-bay options (open-bay confined, open-bay semiconfined, and open-bay unconfined), and ocean placement by pipeline (in parts of Reach 1 and all of reaches 5 and 6) met all Screening Criteria and were carried forward into the matrix analysis.

2.7 PRELIMINARY COST ESTIMATE

The matrix analysis did not put point values on cost. However, the different placement options have different costs and should these costs be very large, cost would have to be taken into account. Therefore, a preliminary cost analysis was conducted and the results are presented in Table 2-5. These preliminary costs were prepared before some of the Screening Criteria were analyzed by the ICT, so some costs are included, for information purposes, for options that have been excluded by the Screening Criteria.

TABLE 2-5

PRELIMINARY COST ANALYSIS

AVERAGE COST PER CUBIC YARD BY REACH AND PLACEMENT OPTION

3/25/03

	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6
OCEAN PLACEMENT WITH HOPPER DREDGES	$57.98	$58.13	$58.05	$52.50	$31.77	$30.10
OCEAN PLACEMENT WITH PIPELINE DREDGES AND SCOWS	$21.13	$30.47	$23.91	$9.22	$15.55	$10.35
OCEAN PLACEMENT BY PIPELINE	$18.07	Not feasible	Not feasible	Not feasible	$46.63	$11.87
UPLAND CONFINED PLACEMENT, Present Practice for Reach 3	$5.63	$4.28	$0.88	$4.26	$17.24	$5.74
UPLAND, THIN SHEET	$4.48	$3.63	Not feasible	$3.29	$15.18	$4.71
OPEN BAY CONFINED Pump to "The Hole" for Reach 3	$2.10	$1.48	$2.48	$1.82	$4.37	$2.06
OPEN BAY SEMI-CONFINED	$1.39	$1.06	$1.81	$1.22	$3.09	$1.36
OPEN BAY, Present Practice for Reaches 1,2,4,5,6	$0.72	$0.66	$1.33	$0.65	$1.88	$0.74

RATIO TO PRESENT PRACTICE BY REACH AND PLACEMENT OPTION+

	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6
OCEAN PLACEMENT WITH HOPPER DREDGES	69.35	76.24	56.11	69.13	14.52	35.20
OCEAN PLACEMENT WITH PIPELINE DREDGES AND SCOWS	25.27	39.96	23.11	12.13	7.10	12.10
OCEAN PLACEMENT BY PIPELINE	25.71	Not feasible	Not feasible	Not feasible	24.42	14.97
UPLAND CONFINED PLACEMENT, Present Practice for Reach 3	5.72	5.48	1.00	5.93	7.56	6.80
UPLAND, THIN SHEET	4.54	4.66	Not feasible	5.22	2.94	3.98
OPEN BAY CONFINED	2.32	1.91	2.78	2.39	1.93	2.13
OPEN BAY SEMI-CONFINED	1.69	1.48	2.25	1.74	1.50	2.58
OPEN BAY, Present Practice for Reaches 1,2,4,5,6	1.00	1.00	1.85	1.00	1.00	1.00

Cost do not include (1) EISs, or equivalent, for ocean placement; (2) land purchase/law suits for upland sites; or (3) costs for navigation changes/problems for any options.

2.8 MATRIX ANALYSIS

2.8.1 Ranking System

The ICT recommended the following guidance for scoring the various placement alternatives relative to their impact on the various Evaluation Criteria or Receptors. As shown below, the scores ranged from –3 for negative impacts to +3 for beneficial impacts, with 0 being the impact of the present placement practice for dredging the GIWW through the Laguna Madre. The present practice was considered the baseline against which all comparisons for all alternatives were made. Thus, the present practice was assigned a score of 0, not necessarily because there was no impact, but to show how each alternative differed in its impact from the present practice, either positively or negatively. The score and a description of each is as follows:

- + 3 potentially overriding benefits, thus, critical to decision making;
- + 2 significant positive improvement considering magnitude of net change and the value of the resource;
- + 1 environmentally preferable to impacts on resource than current practice;
- 0 same or equivalent impact on resource as current practice;
- – 1 environmentally less preferable impacts on resources than current practice;
- – 2 significant negative impact considering magnitude of net change and the value of the resource;
- – 3 potentially unacceptable impacts to resources.

2.8.2 Scoring Criteria

In the process of deriving the scores of the various Placement alternatives, the ICT determined that for consistency, criteria would have to be established relative to the sizes of areas impacted, quantities of various water column effects, various human use impacts, etc. that would be assigned to each of the scores presented in the previous section. The following are the results of the ICT's deliberations.

2.8.2.1 Areal Impacts

For areal impacts, such as burying seagrasses, open-bay bottom, emergent bay habitat, and terrestrial habitat, alternatives that impact less than 1 acre relative to current practices were assigned a score of 0. If the impact area was between 1 and 100 acres, relative to present practice, the alternative was assigned a score of 1. If the impact area was greater than 100 acres but no more than 1,000 acres, relative to present practice, the alternative was assigned a score of 2. For an areal impact greater than 1,000 acres, relative to present practice, the alternative was assigned a score of 3. In all cases, the score was a "+", if the impact was positive, and "–", if the impact was negative. Other examples of areal impacts are 1) the area of a receptor that would be impacted by laying and removing pipelines for upland placement, and 2) dredging channels to contain booster pumps required for long pumping distances. Scoring for destruction of piping plover habitat, where piping plovers have actually been found in past investigations, is a 0 (zero) if no sites of habitat are destroyed; a –1 if 1 to 10 sites are destroyed; a –2 if 11 to 100 sites are destroyed; and a –3 if more than 100 sites are destroyed. For impacts to benthos (bay bottom), solid phase (SP) bioassay and bioaccumulation data were examined. Since these data are not amenable to areal impact descriptions, a score of –1 was applied if the (see Section 2.4) LPC for SP bioassays was not met, a –2 was applied if the LPC for bioaccumulation was not met, and a –3 was applied if both were not met.

2.8.2.2 Water Column Effects

For water column impacts for constituents for which there are numerical criteria in the WQS, two zones were used: the Zone of Initial Dilution (ZID) and the Mixing Zone (MZ). The ZID and MZ are described in the Texas Surface Water Quality Standards (30 TAC §§307.1-307.10) and the implementation of the TCEQ Standards via Permitting (TNRCC, 1995). For open bays, they are defined as the volume of water within a 50-foot and 200-foot radius of the discharge point, respectively.

The elutriate was used as the measure of water column impact of a particular constituent, after accounting for the concentration of that constituent in the waters of the Laguna Madre. For consistency with §§307.1–307.10, if the acute marine WQSs were not exceeded at the end of the discharge pipe, a score of 0 was assigned. If the acute marine WQSs were exceeded at the end of but not beyond the discharge pipe but were not exceeded inside of the ZID (i.e., allowing for mixing that would occur in the ZID), a score of –1 was assigned. If the acute marine WQSs were exceeded inside but not beyond the ZID, a score of –2 was assigned. If the chronic marine WQSs were exceeded in but not beyond the MZ, a score of –3 was assigned. In actuality, an examination of the data indicated a few stations from the 1980s for which slight exceedance of WQSs would have occurred at the end of the discharge pipe only. However, the instances were few and all recent data indicated no exceedances, so no scoring was based on chemical analyses of the elutriates.

For turbidity, the with-placement scenario was compared with the without-placement scenario for the sediment transport modeling. If TSS, under these circumstances, increased by more than 25 milligrams per liter (mg/L) for at least 3 months, a score of –1 was assigned; more than 50 mg/L for at least 3 months, a score of –2 was assigned; and more than 100 mg/L for at least 3 months, a score of –3 was assigned. This determination was based on potential impacts to seagrasses provided in the results of the Seagrass Modeling (Burd, 2001). Additionally, an examination was made of plots provided in Teeter (2000) that compared the isopleths (lines of equal value) for 20 percent irradiance reaching the seagrasses, with and without open-bay dredged material placement. The differences in areas were estimated and summed by reach, in acres. These acre values were assigned a score the same as the acres of other areal impacts noted above.

For other constituents, bioassay data were examined and the toxicity limitations given in §§307.6(c)(7) were applied to the zones noted above, such that if the toxicity criterion was not violated at the discharge pipe, a score of 0 was assigned. If the toxicity criterion was exceeded only inside the ZID, a score of –1 was assigned; outside the ZID but not outside the MZ, a –2 was assigned; and outside the MZ, a –3 was assigned. Since water column impacts were estimated by several different methods, the individual scores applied by each method were divided by the number of methods used for that particular activity so that the total score for any activity, per reach, for water column impacts did not exceed 3. In actuality, like the elutriate discussion noted above, no scoring occurred with this method since violation of the toxicity criterion was not indicated by any of the data.

In addition to water quality impacts, there were other water column impacts from some alternatives. Creation of open-bay confined and open-bay semiconfined placement areas would displace a volume of water that was available to nekton and plankton. Considering the volume of the placement areas versus the volume of water in the Laguna Madre, this is a small but real impact, but one which is difficult to quantify. Therefore, it was assigned a value of –1.

2.8.2.3 Human Use Effects

Human Use Effects was a complicated receptor category. It was comprised of considerations concerning commerce, recreation, fishing, hunting, tourism, human safety, and land use. Impacts to commerce were reflected in the dredging frequency and duration, since this could affect barge traffic in the GIWW. These two items also affect recreation, fishing, hunting, and tourism since people engaged in these activities often use the GIWW for access to their destinations. The length of pipeline involved in dredged material placement and the duration of dredging affect human safety, as well as recreation, fishing, hunting, and tourism since pipelines running in the GIWW reduce access into and egress from the GIWW. Pipelines running perpendicular to the GIWW and emergent placement areas restrict movement in the Laguna Madre and provide a potential danger to boaters. Upland confined placement areas impact the land use of the landowners, but may provide bird hunting benefits, as may open-bay confined placement. However, impacts to land owners are quantifiable whereas potential benefits to bird hunting is not.

Dredging duration in days for dredging and levee construction was listed under Dredging Activity, since together they equal the total impact to human use for the GIWW, and were scored as follows: differs by less than 100 days = 0, differs by 100 – 500 days = 1, differs by 500 – 1,000 day = 2, and differs by >1,000 days = 3. Pipeline lengths and duration are presented as the number of pipeline-mile-days (pmd) per 50 years. Land use impacts are presented as acres and scored like all other acreages. For pmd, the ICT determined that 0 – 100 pmd received a score of 0; 101 – 2,500 pmd, a score of 1; 2,501 – 10,000 pmd, a score of 2; and >10,000 pmd, a score of 3. There are coastal cabins located on dredged material placement areas in some reaches. These cabins and associated structures are permitted by the GLO. The creation of open-bay confined and open-bay semiconfined placement areas has the potential to destroy some of these cabins, with impacts to the human uses of those facilities. Scoring for destruction of coastal cabins is a 0 if none are destroyed; a –1 if 1 to 10 are destroyed; a –2 if 11 to 100 are destroyed; and a –3 if more than 100 are destroyed. Long-term aesthetic impacts were given a score of 0 for levee heights <20 feet, a score of –1 for levee heights of 21 to 35 feet, a score of –2 for levee heights of 36 to 50 feet, and a score of –3 for levee heights >50 feet. As with other receptors, if more than one method was applied to Human Use Effects, an average was used such that the maximum score by reach, per activity, did not exceed 3.

2.8.3 Activities

After considerable discussion and trying to assign a score to the impacts of maintenance dredging and dredged material placement to the various receptors, the ICT determined that the process of maintenance dredging would have to be broken into various activities before one could logically examine impacts. Therefore, the impact from each alternative on any given receptor was broken into four activities: dredging impacts, impacts from the conveyance of dredged material, impacts from the placement of the dredged material, and post-placement impacts.

Dredging Activity impacts are those that occur during and because of the dredging, *per se*, and are independent of the transport and/or placement of the dredged material. These include the turbidity at the dredging site and impacts to benthos that might be in the maintenance material. Conveyance Activity impacts are those that occur during and because of the transport of the dredged material from the dredge to the placement area. These include impacts to human health and fisheries economics from pipelines across the Laguna Madre, impacts to seagrass and benthos from laying pipelines across the Laguna, impacts to seagrass and benthos from dredging canals to place booster pumps, etc. Placement Activity impacts are those associated solely from the placement of dredged material. These include impacts to terrestrial flora and fauna from the creation of upland placement areas, impacts to seagrass and benthos from creation of open-bay confined or semiconfined placement areas, turbidity from open-bay unconfined placement, etc. Post-placement Activity impacts are those associated with the fact that some placement options have long-term implications for various ecosystems or are outside the footprint of the placement site. For example, open-bay nonconfined and semiconfined placement would allow dredged material to flow outside of the placement area. Upland confined and open-bay confined may reduce the frequency of dredging as well as reducing the turbidity from resuspension of placed material.

2.9 INFORMATION ON PLACEMENT ALTERNATIVES

This section provides additional information used in the generation of the Point Values that went into the Matrix. It includes a discussion of the various basic placement options: i.e., offshore; upland; beach nourishment; open-bay; confined; and semiconfined; and what types of impacts these various options will cause. Like the cost data, some of this information was developed before the Screening Criteria were applied and some was required for application of the criteria. Therefore, data concerning some options, which have been excluded by the Screening Criteria, are included for information purposes only.

2.9.1 Present Practices

2.9.1.1 Reach 1

At present, all maintenance material from Reach 1 is placed in PAs 176–191, which are unconfined, open-bay placement areas, except for PA 176, which is confined.

2.9.1.2 Reach 2

At present, all maintenance material from Reach 2 is placed in PAs 192–202, which are unconfined, open-bay placement areas, except that part of PA 202 is confined.

2.9.1.3 Reach 3

Presently, maintenance material from Reach 3 is placed in PAs 203, 204, 206–210 in the Land Cut. PA 204 is completely leveed, while parts of PAs 203, 206, 207, and 208 are partially leveed. PA 210 has some incomplete levees to direct the flow of dredged material away from the GIWW. Since, under ordinary circumstances, little dredging is required in this reach, there is sufficient capacity in the present placement areas for the 50-year life of the project.

2.9.1.4 Reach 4

At present, all maintenance material from Reach 4 is placed in PAs 211–222, which are unconfined, open-bay placement areas, except that PA 211 has some incomplete levees to direct the flow of dredged material away from the GIWW and part of PA 222 is confined.

2.9.1.5 Reach 5

At present, all maintenance material from Reach 5 is placed in PAs 223–228, which are unconfined, open-bay placement areas, except that PA 226 is confined and PA 225 is semiconfined.

2.9.1.6 Reach 6

At present, all maintenance material from Reach 6 is placed in PAs 229–239, which are unconfined, open-bay placement areas.

2.9.2 Offshore

For all material to go offshore (i.e., ocean placement), three options were examined: oceangoing hopper dredges, pipeline dredges and hopper barges or scows, and pipeline dredges and pipelines. All of these options would remove maintenance material from the Laguna Madre system, so that the future maintenance frequencies were reduced by 14 percent to account for this. This percentage reduction was based on information derived from the Sediment Transport Computer Model, conducted by the Waterways Experiment Station of the USACE (Teeter, 2000).

2.9.2.1 Oceangoing Hopper Dredges

Because of their size, these dredges are not able to turn around in the GIWW, without dredging a turnaround basin. A series of dredged turnaround basins in the Laguna Madre was not included as a viable possibility. The dredges would have to enter and exit the GIWW through three possible channels: Corpus Christi (CC), Port Mansfield (PM), and Brazos Island Harbor (BIH). For example, for Reaches 1, 2, 3, and most of 4 (the CC-PM Section), the dredge would enter via the Corpus

Christi Ship Channel, locate the position of last dredging, dredge until full, exit through the Port Mansfield Channel, and deposit the dredged material in a Port Mansfield ODMDS. The dredge would then reverse this procedure, entering at Port Mansfield and depositing the dredged material in a Corpus Christi ODMDS. It would then go back through the GIWW to the Port Mansfield Channel ODMDS, etc. For the rest of Reach 4, and for all of Reaches 5 and 6 (the PM–PI Section), this scenario would be repeated using BIH and Port Mansfield ODMDSs. Three full-time dredges and one at 44 percent of the time would be required for Reach 1. Five full-time dredges would be needed for Reach 2 and one at 50 percent; three dredges in Reach 3 at 100 percent and one at 52 percent. Four dredges would be needed in the northern portion of Reach 4 at 100 percent and one at 42 percent; one dredge in the southern portion of Reach 4 at 63 percent; one dredge in Reach 5 at 39 percent; and two dredges in Reach 6 at 100 percent and one at 23 percent. Dredging of the various reaches could not be conducted independently but would have to be carefully coordinated. Looking at the CC–PM section as one large reach for ocean placement purposes, there would be an average of 16.9 dredges, going up and down the GIWW, 24 hours per day. There would be an average of 3.2 dredges in the PM–PI Section. These two combined would yield a minimum of 20.1 dredges/day (13,117 trips/year) in the GIWW through the Laguna Madre, assuming that needs for maintenance dredging in the various reaches could be accomplished using the fewest possible dredges and that this number of dredges could be located and made available. This represents an increase of 880 percent over the 1,681 self-propelled commercial vessel trips through this portion of the GIWW (both directions) during 1997 (USACE Navigation Data Center, Waterborne Commerce Statistical Center, 2000). An 880 percent increase in vessel traffic would greatly increase both bank erosion and the possibility of a spill by collision in the Laguna. New ocean placement sites, or expansion of present sites, would be required, necessitating the preparation of site designation EISs.

Assumptions made in the impact analysis are 1) the use of a 1,300-cy dredge (roughly 130 cy of dredged material would be transported per round trip since maintenance material is typically 20 percent solids; the dredge is half-loaded; and no overflow to increase the solids content is allowed, because that would cause the release of suspended solids; a dredge larger than this would not be able to work the GIWW), 2) 8.1-mile per hour (mph) speed loaded and 10.8-mph speed unloaded (Lockhart, pers. comm.), 3) 112.5-mile round trip for CC–PM section and 53.2-mile round trip for the PM–PI section, 4) 1 hour of dredging to fill hoppers, 5) a 20-hour average workday, and 6) that dredges of this size could pass under the causeways at each end. The last assumption is valid, but there is only a few feet of clearance for the JFK Causeway and then only in the very center of the causeway.

Reach 1 maintenance would require 5,519 trips and 117.0 dredging-months per dredging cycle by oceangoing hopper dredges, which would travel a total of 620,859 miles. With a 34.0-month dredging frequency, dredging could not be completed with only one dredge.

Reach 2 maintenance would require 8,402 trips and 178.1 dredging-months per dredging cycle by oceangoing hopper dredges, which would travel a total of 945,236 miles. With a 32.4-month dredging frequency, dredging could not be completed with only one dredge.

Reach 3 maintenance would require 4,878 trips and 103.4 dredging-months per dredging cycle by oceangoing hopper dredges, which would travel a total of 548,820 miles. With a 29.4-month dredging frequency, dredging could not be completed with only one dredge.

Reach 4 maintenance would require 3,852 trips and 83.8 dredging-months per dredging cycle in the northern part and 1,094 trips and 11.9 dredging-months per dredging cycle in the southern part by oceangoing hopper dredges, which would travel a total of 444,608 and 58,179 miles, respectively. With a 19.0-month dredging frequency, dredging in the northern part could not be completed with only one dredge.

Reach 5 maintenance would require 1,204 trips and 13.1 dredging-months per dredging cycle by one oceangoing hopper dredge, which would travel a total of 64,051 miles. Reach 5 is the only reach in which dredging could be completed by only one dredge.

Reach 6 maintenance would require 4,738 trips and 51.6 dredging-months per dredging cycle by oceangoing hopper dredges, which would travel a total of 252,043 miles. With a 23.2-month dredging frequency, dredging could not be completed with only one dredge.

In addition to the above, hopper dredges are not allowed to be used in some areas because of the potential for greater impacts to sea turtles by these dredges.

2.9.2.2 Cutterhead Suction Dredges

These dredges are the same cutterhead pipeline dredges that are used for present practice in the Laguna Madre, except that, instead of pumping the short distance into the designated placement areas, they would pump long distances to the ocean or would pump into hopper barges or scows.

Cutterhead Suction Dredges and Scows

When this analysis was being conducted, there were two 4,000 cy scows and two 2,000 cy scows available for use on the Texas Coast (G&B, 1997). To be used in the GIWW, these barges could only be half-loaded, so the amount of maintenance material that can be moved by tugs and scows is 1,200 cy per trip to the ODMDSs, assuming that the material coming from the suction head into the scows is 20 percent solids and no overflow to increase the solids content is allowed, because that would cause the release of suspended solids. To arrive at rough costs for this placement alternative, it was assumed that while the scows were being filled, the tugs which brought the scows from the ODMDSs would untie and go to the other end of the scow, so that the one-way trip scenario discussed above for hopper barges would not be true for pipeline dredges and scows. Even so, the average round-trip distances to the ODMDSs are not short, ranging from 30 miles in Reach 4 to 111 miles for Reach 2. Therefore, the amount of material that can be removed from the GIWW each day is dependent on the amount that can be transported in the scows, not the amount that can be dredged (approximately 1,800 cy/hour = 43,200 cy/day). Therefore, the amount of maintenance material that can be removed each day ranges from 865 cy for Reach 2 to 3,200 cy for Reach 4, leading to dredging times per dredging cycle ranging from 44 days (0.1 years) for the southern part of Reach 4 to 1,263 days (3.5 years) for Reach 2. The per-reach dredging time only exceeds the per-reach dredging cycle for Reach 2. However, as can be seen from the table (Table 2-__) included at the end of this section, for all reaches, three dredges and associated scows would be required 100 percent of the time and a fourth would be needed roughly 23 percent of the time. Thus, for this alternative, at all times there would be three dredges and 12 scows and tugs in the GIWW, 24 hours per day. During 23 percent of each year, there would be four dredges and 16 scows and tugs in the GIWW, 24 hours per day. The following table (Table 2-6) presents the following for each reach (Reach 4 is divided into North and South of Port Mansfield): the time required to dredge the reach (Dredging Time); the frequency with which the reach has been historically dredged, reduced by 14 percent for removal of sediment from the Laguna Madre system (Dredging Cycle); the amount of time in each dredging cycle when dredging would actually be occurring with one dredge and four scows (Dredging Time/Dredging Cycle); the number of round trips by scow-tug combination per dredging cycle (Number of Trips); and the number of miles covered by the scows and tugs per cycle (Number of Miles).

TABLE 2-6

PARAMETERS FOR CUTTERHEAD SUCTION DREDGES AND SCOWs

Reach	Dredging Time	Dredging Cycle	Dredging Time/ Dredging Cycle	Number of Trips	Number of Miles
1	1.6 years	2.8 years	0.55	2,391	181,751
2	3.5 years	2.7 years	1.28	3,641	404,141
3	1.6 years	2.5 years	0.63	2,114	181,802
4 North	0.4 years	1.6 years	0.28	1,713	51,377
4 South	0.1 years	1.6 years	0.08	474	14,217
5	0.2 years	2.8 years	0.08	522	25,564
6	0.6 years	1.9 years	0.33	2,053	73,907
Total			3.23	12,908	932,759

This alternative would lead to a minimum of 12.9 scow/tug trips/day (5,684/year) in the GIWW through the Laguna Madre, assuming that needs for maintenance dredging in the various reaches could be accomplished using the fewest possible barges and that this number of barges could be located and made available. This represents an increase of 438 percent over the 1,681 self-propelled commercial vessel trips through this portion of the GIWW (both directions) during 1997 (USACE Navigation Data Center, Waterborne Commerce Statistical Center, 2000). A 438 percent increase in vessel traffic would greatly increase both bank erosion and the possibility of a spill by collision in the Laguna Madre. New ocean placement sites, or expansion of present sites, would be needed, requiring the preparation of site designation EISs.

Cutterhead Suction Dredges with Pipeline Discharge

In most of Reaches 1 and 4 and all of Reaches 2 and 3, the pipelines to the ocean would have to cross the PINS, which violates the Federal Regulations Screening Criterion. An option would be to run the pipeline along the GIWW, north or south of the PINS, and then go offshore. In the other portions of Reaches 1 and 4 and the other reaches, channels across the Laguna Madre would have to be dredged each dredging cycle for the boosters that would be required to push the material all the way to the ODMDSs, which would require the preparation of a number of site designations EISs. Additionally, boosters would be needed because of the long pumping distances and there is a 10 percent loss of volume pumped for each booster used (USACE data). With a booster needed every 2 miles (USACE data), any reach over 22 miles (116,160 feet) would require so many boosters that there would be no discharge at the end of the pipe. Therefore, this placement alternative is not feasible. This applies to all reaches where direct routes would cross the PINS, including the northern portion of Reach 4, since a pipeline run along the GIWW north or south of the PINS and then offshore would average longer than 22 miles.

Acres of impact are provided below (Table 2-7), based on the approximate percentage of seagrass to open-bay bottom in the reach. Since precise routes were not available, precise determinations of seagrass to open-bay bottom ratios were not possible. The area for the channels for booster pumps is a subset of the Laguna Madre area needed for pipeline placement since the pipelines would be connected to the boosters and, therefore, run in the channels. However, while the pipeline placement would be a recurrent but temporary impact, the dredging of channels for booster pump placement would be a permanent removal of habitat. Dredging and construction days for Human Use Impacts are also presented.

TABLE 2-7

SUMMARY OF MATRIX IMPACTS FOR CUTTERHEAD SUCTION DREDGES WITH OFFSHORE PIPELINE DISCHARGE

Reach	Seagrass (ac)	Bay Bottom	Emergent Habitat	Terrestrial Habitat	Dredging and Construction Days
1	61	75	0	59	2,591
5	82	0	72	15	721
6	124	10	7	24	1,942

2.9.3 Upland

2.9.3.1 Confined Upland

This option presumes placement in new, leveed sites on the mainland (Upland Confined Placement Areas [UCPAs]), except for Reach 3. Sites would have to be selected and the State of Texas, as local sponsor, would be responsible for land acquisition. Although UCPAs were identified on a map distributed to the ICT, these sites are not necessarily available and were selected only to calculate typical distances for cost estimates. However, even though upland placement of dredged material may not be immediately feasible due to the lack of easements, point values were assigned.

The sizes of the UCPAs, for initial storage, were calculated by the formulae used in the Automated Dredging and Disposal Alternatives Management System (ADDAMs) models developed at the Waterways Experiment Station of the Corps of Engineers (USACE, 1987. EM 1110-2-50270). Assumptions used to calculate the areas are: 1) levee height sufficient to allow a freeboard of 2 feet and a ponding depth of 2 feet, 2) in situ water content of 98.3 percent, 3) 24-inch pipeline with a discharge rate of 15 fps, 4) average operating day of 18 hours at 1,800 cy per hour (reduced for pipelines and boosters, where appropriate), and 5) TSS in the discharge to be ≤300 mg/L (allowed by the 2-foot ponding depth). The levee height was adjusted in the formulae to 30 feet, since that is approximately the maximum levee height attainable with GIWW material (Hrametz, pers. comm.). The grain size distribution from the USACE historical database and from LWA (1998a), the salinity data from LWA (1998a), and the measurements conducted for Morton (1998) on GIWW maintenance material in the Laguna Madre were used in the calculations. Sites were chosen to allow for reasonable pipeline distances. Impact areas for pipelines assume that a 100-foot swath would be affected during the emplacement and removal of the pipelines and that channels would have to be dredged for booster pumps. The initial storage requirement is the maximum required by the ADDAMS formulae for all material to be dredged during 50 years with 30-foot levees. No allowance was made for compaction between dredging cycles, so placement area sizes are worst case. Some compaction will occur between dredging cycles and, innovative techniques could increase the amount of compaction, thus reducing the required levee heights or placement area sizes. However, any such determinations are unnecessary for the alternatives analysis since the same formulae were used for all reaches. This scenario, like ocean placement, would remove the maintenance material from the system, so that the future maintenance frequencies were reduced by 14 percent.

As noted above, all reaches were broken into segments to prevent the distance from the dredge to the UCPA from exceeding 7 miles, which does not show new sites in Reach 3, since existing upland areas, including some leveed placement areas already exist. The table below (Table 2-8) presents a summary of the calculated results.

TABLE 2-8

PLACEMENT AREA DESCRIPTORS BY REACH

	Reach 1			Reach 2		Reach 3			
Segment:	1	2	3	4	5	6	7	8	9
External Area Initial (acres)	76	178	343	270	601	73	300	141	72
Levee Heights Long-Term (feet)	30	30	30	30	30	30	30	30	30

TABLE 2-8 (Concluded)

	Reach 4				Reach 5		Reach 6		
Segment:	10	11	12	13	14	15	16	17	18
External Area Initial (acres)	290	244	298	161	104	52	251	444	56
Levee Heights Long-Term (feet)	30	30	30	30	30	30	30	30	30

The external acreages above for Reach 3 total 586 acres, while the total amount of emergent acreage is roughly 2,576 acres. Therefore, there should be no impacts on piping plover habitat or coastal cabins in Reach 3.

Additionally, the following table (Table 2-9) presents the acres of various receptors from the pipelines that would need to be placed across the Laguna and upland areas to the placement areas. The area for the channels for booster pumps is a subset of the Laguna Madre area needed for pipeline placement since the pipelines would be connected to the boosters and, therefore, run in the channels. However, while the pipeline placement would be a recurrent but temporary impact, the dredging of channels for booster pump placement would be a permanent removal of habitat. Acres of impact are provided below, based on the approximate percentage of seagrass to open-bay bottom in the reach. Since precise routes were not available, precise determinations of seagrass to open-bay bottom ratios were not possible.

TABLE 2-9

ACRES OF MATRIX IMPACTS FOR PIPELINE PLACEMENT BY REACH

Reach	Seagrass (ac)	Bay Bottom (ac)	Emergent Habitat (ac)	Terrestrial Habitat* (ac)
1	23	28	40	12
2	8	18	10	1
3	0	0	0	0
4	40	59	16	9
5	29	10	30	0
6	38	42	4	28

* While not quantifiable, there would be losses of Terrestrial Habitat from road construction associated with placement area construction.

ac = acres.

The following table (Table 2-10) presents the dredging/construction days and pmd, per 50 years, for conveyance of dredged material by reach and the acres of land use involved in placement.

TABLE 2-10

SUMMARY OF HUMAN USE MATRIX IMPACTS FOR
UPLAND CONFINED PLACEMENT BY REACH

Category	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6
Days	1,317	1,613	870	1,639	258	428
pmd	9,217	11,288	870	11,473	1,808	2,998
Land use	609	872	586	1,000	156	779

There are 31 coastal cabins on existing placement areas in Reach 3, none of which would be affected by confined upland placement in Reach 3.

2.9.3.2 Thin Layer

This placement option allows dredged material to be placed on an upland area, as a beneficial use. In general, a small levee or dike is used parallel to the channel being dredged, and possibly one or two others perpendicular to the channel, to keep the dredged material from flowing back into the channel. The placement is designed so that a sediment layer roughly 6–12 inches thick is produced. A layer such as this allows nutrients in the dredged material to be transferred to the soils but allows the salt content to be reduced by rain such that relatively rapid revegetation can occur. The results of an experimental thin-layer placement have been described in TAMU (1999).

Since the dredged material would be pumped to the Thin Layer Upland Placement Areas, just as it would for the Upland Confined Placement alternative, the same segments noted in Section 2.9.2.1 were used for Thin Layer. This option is not feasible for Reach 3 because there is insufficient upland area that would benefit from this type of treatment in this reach. Additionally, because of the size of the area impacted, this alternative would only be considered with the consent of a landowner. Based on an average thickness of 6 inches of material, after drying, the areal extent of the placement areas by reach and segment; and the acres of seagrass, bay bottom, and terrestrial habitat that would be impacted by the pipelines conveying the material to the placement areas, by reach, are presented below (Table 2-11). Acres of impact are based on the percentage of seagrass to open-bay bottom in the reach. Since precise routes were not available, precise determinations of seagrass to open-bay bottom ratios were not possible. The area for the channels for booster pumps is a subset of the Laguna Madre area needed for pipeline placement since the pipelines would be connected to the boosters and, therefore, run in the channels. However, while the pipeline placement would be a recurrent but temporary impact, the dredging of channels for booster pump placement would be a permanent removal of habitat. The impacts from the pipeline corridors are the same as those for upland confined, but the placement area size is not.

TABLE 2-11

SUMMARY OF MATRIX IMPACTS FOR
THIN LAYER PLACEMENT BY SEGMENT

Reach	Segment	PA (ac)	Seagrass (ac)	Bay Bottom (ac)	Emergent Bay (ac)	Terrestrial Habitat* (ac)
1	1	1,758				
1	2	4,563	23	28	40	12
1	3	9,417				
2	4	7,904				
2	5	17,261	8	18	10	1
3	6	Not feasible				
3	7	Not feasible				
3	8	Not feasible				
3	9	Not feasible				
4	10	7,837				
4	11	6,283				
4	12	7,826	40	59	16	9
4	13	3,861				
5	14	2,471				
5	15	973	29	10	30	0
6	16	6,453				
6	17	12,230	38	42	4	28
6	18	1,164				

* While not quantifiable, there would be losses of Terrestrial Habitat from road construction associated with placement area construction.

ac = acres

The following table (Table 2-12) presents the dredging/construction days and pmd, per 50 years, for conveyance of dredged material by reach and the acres of land use involved in placement.

TABLE 2-12

SUMMARY OF HUMAN USE MATRIX IMPACTS FOR
THIN LAYER PLACEMENT BY REACH

Category	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6
Days	1,317	1,613	N/A	1,639	238	428
pmd	9,217	11,288	N/A	11,473	1,608	2,998
Land use	15,674	25,097	N/A	25,816	3,444	19,874

2.9.4 Beach and Washover Nourishment

Beach Nourishment would be by transportation of dredged material from the GIWW to the beaches of South Padre Island to replenish sand, which is being eroded by natural processes. For washover nourishment, the pipelines would go to selected washover areas. For nourishment to occur, pipelines would have to be laid from the GIWW across the bays and islands to the beach or washover. These pipelines would normally be floated on the bay surface, causing problems for recreational boaters, especially at night. To ease this problem for recreational boaters, a submerged section could probably be included every few thousand feet for recreational boaters to pass easily over the submerged pipeline at low tide, provided water depths are sufficient.

A formal site designation from the EPA would not be required for beach or washover nourishment, but all information necessary to demonstrate lack of impact would be required. This basically includes putting the results of past testing conducted on the dredged material into a format sufficient to satisfy the Section 404(b)(1) Guidelines.

The primary difficulty with beach and washover nourishment is that only Reach 3 material, which has the most sand of any reach at 75 percent sand, on average, is marginally suitable for nourishment due to grain size. The material from the other reaches ranges from 51 to 9 percent sand with a high silt fraction. Therefore, only the material from Reach 3 can be used feasibly for nourishment. Additionally, for all of Reaches 2 and 3, and parts of Reaches 1 and 4, the pipeline would have to cross the PINS, which violates the Federal Regulations Screening Criterion. Reach 3 also does not have sufficient washover areas to accommodate all of the maintenance material from the GIWW, even if the grain size were coarser to match existing sediments.

2.9.5 Open Bay

Open-bay placement is of three varieties: unconfined, which would be a continuation of existing practice for all Reaches except Reach 3, semiconfined, and confined. For Reach 3, new sites would be required in the popular fishing spot known as The Hole for open-bay placement to be used. Because of the concerns for which this DEIS is being prepared, transporting material by pipeline out of the Land Cut for placement in the Laguna Madre would not be logical and was not recommended by the ICT.

2.9.5.1 Unconfined

As noted above, open-bay unconfined placement would be the continuation of the present practice in all reaches, except for Reach 3 in the Land Cut. Material is dredged by a cutterhead pipeline dredge and pumped via pipeline into the existing open-water placement areas and allowed to flow by gravity and currents onto the Laguna bottom. Mounding occurs next to the discharge pipe and the dredged material feathers out from there. Potential impacts would include burial of benthic organisms and seagrasses and increased turbidity. Seagrasses can endure burial of roughly 3 inches (Dunton et al., 2002). Since 6 inches of accumulation was assumed for the calculation of the Thin Layer Placement option and since not all material stays on site with open-bay unconfined placement, the same acreages as Thin Layer were used to calculate the area of impact for open-bay unconfined placement. These are

Reach 1: 948 acres (853 seagrass, 95 bay bottom); Reach 2: 1,517 acres (737 seagrass, 780 bay bottom); Reach 3: 820 acres (533 seagrass, 287 emergent land); Reach 4: 957 acres (362 seagrass, 595 bay bottom); Reach 5: 151 acres (122 seagrass, 29 bay bottom); and Reach 6: 746 acres (298 seagrass, 448 bay bottom). These acreages were used in the impacts to seagrass, bay bottom, and emergent habitat. For Reach 3, Open-Bay Unconfined placement would involve piping material to The Hole, which would impact seagrasses and sand/algal flats.

The following table (Table 2-13) presents the acreage between the isopleths for 20 percent irradiance reaching the seagrasses, with and without open-bay dredged material placement, by month for the first 3 months after dredging and unconfined open-bay placement from the model of 'worst case' scenario. The 3-month average was used for scoring.

TABLE 2-13

20% IRRADIANCE REDUCTION FOR UNCONFINED OPEN-BAY PLACEMENT BY REACH

Month	Reach1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6
April	0	227	NA	362	17	314
May	0	14	NA	19	0	114
June	0	9	NA	11	14	101
Average	0	80	0*	131	10	176

* This number is assumed based on higher sand content since no open-bay placement was included in the model for Reach 3.

The average TSS was not higher than 25 mg/L for any 3 months after dredged material placement in any reach, according to the modeling conducted for the use of ICT by the USACE Waterways Experiment Station (WES) (Teeter, 2000). Average TSS values above 100 mg/L only occurred in the 119 hours during placement activities. A TSS average above 50 mg/L occurred in Reaches 2 and 4 during the month of simulated placement activities (April 1995) but not after April.

Open-bay unconfined placement has not historically impacted either coastal cabins or piping plover habitat (Drake et al., 1999). The following table (Table 2-14) presents the dredging/construction days and pmd, per 50 years, for conveyance of dredged material by reach and the acres of land use involved in placement.

TABLE 2-14

SUMMARY OF HUMAN USE MATRIX IMPACTS FOR UNCONFINED OPEN-BAY PLACEMENT BY REACH

Category	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6
Days	659	862	1,526	861	78	213
pmd	659	862	21,360	861	78	213

2.9.5.2 Open-Bay Confined

This scenario presumes that all material will be placed in leveed areas, as with upland placement, but the leveed areas would be along the GIWW. This is present practice only for Reach 3. Fifteen feet was considered to be the practical upper levee-height limit for confined placement areas in the open bay, since open-bay levees would be constructed with geotextile tubes (a pyramidal set of six geotextile tubes would be used to achieve a height of 15 feet). Since upland placement sites were designed with constructed earthen levees, up to 33 feet in height, the areas needed for open-bay confined placement are considerably larger than for upland confined placement. The segments used for UCPAs are not used here since the limitation on pumping distance does not apply. Therefore, the area required for each existing placement area has been calculated and compared with the size of the emergent portion of each placement area. This scenario, like ocean placement and upland confined placement, would remove the maintenance material from the system, so that the future maintenance frequencies were reduced by 14 percent (a reduction in the frequency of dredging). Ratios of seagrass to open-bay bottom differ from those used for pipeline and booster channels in the previous sections and were taken from seagrass maps of the placement areas in each reach. The construction of open-bay confined placement areas would also displace a water volume that had been available to nekton and plankton.

Reach 1. This reach contains PAs 175–191. The acreage of each placement area, the emergent land present on each placement area, the maximum acreage required for open-bay confined placement for each placement area, and the amount of additional area that would need to be created, above the emergent land available, is listed below for this reach (Table 2-15). Overall, confined placement would require roughly 1.8 times the placement area of Upland Placement, or approximately 1,003 acres, if it is assumed that the levees are built to a total height of 15 feet, which would allow roughly 11 feet of maintenance material after consolidation. No bay or upland impacts would occur, except those associated with the construction of the additional levees and enclosed placement areas. Habitat similar to that on existing leveed areas in Reach 3 would be created from existing Laguna Madre bottom and emergent areas. These areas would then be periodically covered with maintenance material and impacts similar to those from Upland Confined placement would occur in the placement areas. As noted below, no bay bottom habitat would be needed for PAs 175–184, but roughly 787 acres of Laguna bottom would be covered for PAs 185–191. Of this total, it is estimated that 709 acres would be seagrass and 78 acres would be unvegetated bay bottom. There are 42 coastal cabins on existing placement areas in Reach 1. However, due to the large amount of emergent area available, it appears that only the four of them on PAs 186, 187, and 189, where additional area is required, would be affected by construction of open-bay confined placement areas. Additionally, piping plovers were found on six placement areas in Reach 1 (EH&A, 1993). However, due to the amount of available emergent area versus the much smaller amount of area needed for confined placement on the placement areas with piping plover sites, it would appear that none of these sites will be impacted. There would be 1,919 dredging/construction days and 14,390 pipeline-mile days for Reach 1 over the 50-year period.

TABLE 2-15

ACREAGE BY PLACEMENT AREA FOR CONFINED OPEN-BAY PLACEMENT FOR REACH 1

PA	Total Area	Emergent Area	Area Required for Confined Placement	Additional Area Required
175	29.1	28.4	0.0*	0.0
176**	133.8	113.4	10.2	0.0
177	35.8	27.0	5.9	0.0
178	125.3	78.6	15.3	0.0
179	40.1	23.9	5.1	0.0
180	125.6	76.1	43.2	
181	96.6	58.9	33.0	
182	58.5	36.5	16.1	
183	152.1	59.3	22.7	
184	98.7	43.9	28.2	0.0
185	105.4	33.6	42.9	9.3
186	117.4	2.4	91.2	88.8
187	137.8	0.0	174.2	174.2
188	165.8	0.0	198.1	198.1
189	124.7	0.0	161.5	161.5
190	69.9	0.0	94.3	94.3
191	57.3	0.0	61.1	61.1
Total	1,673.9	582.0	1,003.0	787.3

* Never used.

** PA 176 is partially confined, but will be fully confined during the next dredging cycle it is used.

Reach 2. This reach contains PAs 192–202. For this reach, the same information, as for Reach 1, is provided below (Table 2-16). Overall, confined placement would require roughly 1.9 times the placement area of Upland Placement, or approximately 1,525 acres, if it is assumed that the levees are built to a total height of 15 feet. No bay or upland impacts would occur, except those associated with the construction of the additional levees and emergent areas. Habitat similar to that on existing leveed areas in Reach 3 would be created from existing Laguna Madre bottom areas and these areas would be periodically covered with maintenance material and impacts similar to those from Upland Confined placement would occur in the placement areas. A total of 1,214 acres of Laguna bottom would be covered to create the confined placement areas. Of this, it is estimated that 590 acres would be seagrass and 624 acres would be unvegetated bay bottom. There are 33 coastal cabins on existing placement areas in Reach 2, all of which would be demolished with the construction of open-bay confined placement areas, since additional area is required on all placement areas. Piping plovers were found on two placement areas in Reach 2 (EH&A, 1993), and it would appear that all of that habitat would similarly be covered by creation of the open-bay confined placement areas. There would be 2,284 dredging/construction days and 18,504 pipeline-mile days for Reach 2 over the 50-year period.

TABLE 2-16

ACREAGE BY PLACEMENT AREA FOR CONFINED
OPEN-BAY PLACEMENT FOR REACH 2

PA	Total Area	Emergent Area	Area Required for Confined Placement	Additional Area Required
192	90.6	0.0	53.2	53.2
193	90.6	38.0	5[illegible].6	16.6
194	121.5	24.6	74.9	50.3
195	103.0	0.3	6[illegible].2	67.9
196	103.0	41.2	5[illegible].3	9.1
197	304.4	80.4	34[illegible]	261.4
198	146.2	0.0	16[illegible]	168.5
199	124.9	0.0	170.7	170.7
200	196.2	5.1	169.6	164.5
201	173.7	0.0	183.8	183.8
202	195.6	121.1	189.4	68.3
Total	1,649.7	310.7	1,525.0	1,214.3

Reach 3. This reach contains PAs 203-210, all in the Land Cut (Table 2-17). PA 205 is not used for the GIWW. PA 204 is completely leveed, while parts of PAs 202, 203, 206, 207, and 208 are partially leveed. PA 210 has some incomplete levees to direct the flow of dredged material away from the GIWW. Overall, confined placement would require roughly 1.5 times the placement area of Upland Placement, or approximately 903 acres, if it is assumed that the levees are built only to a total height of 15 feet. Substantial bay impacts would occur since, to achieve open-bay confined placement in Reach 3, confined areas would have to be created in The Hole, an open-water fishing area east of the northern portion of the Land Cut. Habitat similar to that on existing leveed areas would be created from Laguna Madre bay bottom and seagrass habitat and these areas would be periodically covered with maintenance material and impacts similar to those from Upland Confined placement would occur in the placement areas. The Hole is essentially all seagrass or algal/sand flats so that roughly 587 acres of seagrass and 316 acres of algal/sand flats would be buried. There are 38 coastal cabins on existing placement areas in Reach 3, but none would be impacted by construction of open-bay confined placement areas. No piping plovers were found on PAs in Reach 3 (EH&A, 1993, 1997b), but impacts to 316 acres of algal/sand flats would likely impact piping plovers. Channels would have to be dredged into The Hole to provide access for equipment for levee construction. There would be 2,205 dredging/construction days and 30,876 pipeline-mile days for Reach 3 over the 50-year period.

TABLE 2-17

ACREAGE BY PLACEMENT AREA FOR CONFINED OPEN-BAY PLACEMENT FOR REACH 3

PA	Total Area	Emergent Area	Area Required for Confined Placement	Additional Area Required
203	324.5	311.3	66.9	66.9 *
204	167.7	167.7	33.3	33.3
206	380.4	380.4	120.8	120.8
207	322.2	322.2	177.7	177.7
208	769.0	767.0	384.8	384.8
209	193.4	193.4	44.9	44.9
210	242.8	240.7	74.3	74.3
Total	2,400.0	2,382.7	902.7	902.7

* Emergent areas of existing PAs is not applicable for this reach since all PAs would be moved to The Hole.

Reach 4. This reach contains PAs 211–222. The same information, as for Reach 1, is provided below (Table 2-18). PA 211 has some incomplete levees to direct the flow of dredged material away from the GIWW. Overall, confined placement would require roughly 1.8 times the placement area of Upland Placement, or approximately 1,675 acres, if it is assumed that the levees are built to a total height of 15 feet, with 11 feet of maintenance material after consolidation. No bay or upland impacts would occur except those associated with the construction of the additional levees and emergent areas. Habitat similar to that on existing leveed areas in Reach 3 would be created from existing Laguna Madre bottom areas and these areas would be periodically covered with maintenance material and impacts similar to those from Upland Confined placement would occur in the placement areas. A total of 1,514 acres of Laguna bottom would be covered to create the confined placement areas. Of this, it is estimated that 573 acres would be seagrass and 941 acres would be unvegetated bay bottom. There are 6 coastal cabins on existing placement areas in Reach 4, all of which would be demolished with the construction of open-bay confined placement areas. No piping plovers were found on PAs in Reach 4 (EH&A, 1997b). There would be 2,971 dredging/construction days and 17,828 pipeline-mile days for Reach 4 over the 50-year period.

Reach 5. This reach contains PAs 223–228. The same information, as for Reach 1, is provided below (Table 2-19). Overall, confined placement would require roughly 1.5 times the placement area of Upland Placement, or approximately 223 acres, if it is assumed that the levees are built to a total height of 15 feet. No bay or upland impacts would occur except those associated with the construction of the additional levees and emergent areas. Habitat similar to that on existing leveed areas in Reach 3 would be created from existing Laguna Madre bottom areas and these areas would be periodically covered with maintenance material and impacts similar to those from Upland Confined placement would

TABLE 2-18

ACREAGE BY PLACEMENT AREA FOR CONFINED
OPEN-BAY PLACEMENT FOR REACH 4

PA	Total Area	Emergent Area	Area Required for Confined Placement	Additional Area Required
211	140.8	45.4	126.7	81.3
212	192.1	0.0	189.4	189.4
213	191.7	0.0	108.1	108.1
214	191.4	0.0	145.6	145.6
215	194.1	0.0	163.4	163.4
216	194.7	0.0	70.1	70.1
217	193.3	0.0	107.8	107.8
218	194.3	0.0	193.5	193.5
219	119.8	0.0	86.9	86.9
220	216.1	2.0	119.2	119.2
221	387.2	63.3	229.1	165.8
222*	259.4	52.6	135.3	82.7
Total	2,474.9	161.3	1,674.8	1,513.5

* Parts of PA 222 are completely leveed.

TABLE 2-19

ACREAGE BY PLACEMENT AREA FOR CONFINED
OPEN-BAY PLACEMENT FOR REACH 5

PA	Total Area	Emergent Area	Area Required for Confined Placement	Additional Area Required
223	158.8	137.4	38.4	0.0
224	175.4	172.3	14.2	0.0
225	84.3	77.6	7.8	0.0
226*	257.6	247.6	79.2	0.0
227	65.4	43.0	35.6	0.0
228	294.4	115.1	47.9	0.0
Total	1,035.9	793.0	223.0	0.0

* PA 225 is semiconfined and PA 226 is leveed.

occur in the placement areas. No acres of Laguna bottom would be covered to create the confined placement areas. There are 14 coastal cabins on existing placement areas in Reach 5. However, due to the large amount of emergent area available, it appears that none of them would be affected by construction of open-bay confined placement areas. No piping plovers were found on PAs in Reach 5 (EH&A, 1997b). There would be 339 dredging/construction days and 2,035 pipeline-mile days for Reach 5 over the 50-year period.

Reach 6. This reach contains PAs 229–239. The same information, as for Reach 1, is provided below (Table 2-20). Overall, confined placement would require roughly 1.7 times the placement area of Upland Placement, or approximately 1,239 acres, if it is assumed that the levees are built to a total height of 15 feet. No bay or upland impacts would occur except those associated with the construction of the additional levees and emergent areas. Habitat similar to that on existing leveed areas in Reach 3 would be created from existing Laguna Madre bottom areas and these areas would be periodically covered with maintenance material and impacts similar to those from Upland Confined placement would occur in the placement areas. Except for PAs 233 and 234, not much unvegetated bay bottom would be impacted to create the confined, open-bay placement areas, but a total of 1,153 acres of Laguna bottom would be covered if PAs 233 and 234 are included. The USACE attempted to create open-bay, confined placement areas in 1994, at PA 233 and 234, but the strong currents in the area destroyed both the submerged and emergent levees in a relatively short time frame (Morton, 1998). Therefore, as past experience has shown, even if it were found desirable, creating open-bay, confined placement areas at 233 and 234 could be a difficult task. Of the total acres, it is estimated that 461 would be seagrass and 692 would be unvegetated bay bottom. There are 11 coastal cabins on existing placement areas in Reach 6. However, due to the large amount of emergent area available, it appears that none of them would be affected by construction of open-bay confined placement areas. No piping plovers were found on PAs in Reach 6 (EH&A, 1997b). There would be 686 dredging/construction days and 4,799 pipeline-mile days for Reach 6 over the 50-year period.

TABLE 2-20

ACREAGE BY PLACEMENT AREA FOR CONFINED OPEN-BAY PLACEMENT FOR REACH 6

PA	Total Area	Emergent Area	Area Required for Confined Placement	Additional Area Required
229	129.2	50.4	7.9	0.0
230	82.5	46.5	4.4	0.0
231	127.8	67.0	6.7	0.0
232	127.4	52.5	53.4	0.9
233	210.0	14.7	691.8	677.1
234	121.6	0.0	421.6	421.6
235	121.6	0.0	17.3	17.3
236	129.1	0.0	0.1	0.1
239	49.38	0.0	36.3	36.3
Total	1,098.6	231.1	1,239.4	1,153.3

2.9.5.3 Open-Bay Semiconfined

This alternative would allow runoff from existing confined placement areas, or new semiconfined placement areas on emergent land near the GIWW, onto the flats or open water behind the placement areas. In open-bay areas, levees would have to be constructed on the GIWW side of the placement areas, with wing levees extending for some distance perpendicular to and away from the GIWW, with no back levees. This levee system would partially contain the material and thus, theoretically, create emergent areas. Over time, more Laguna bottom would likely be covered than with confined placement.

Placement would require placing geotextile tubes at the existing open-water placement areas, similar to Confined Open-Bay Placement, except that there would be no back levees. While the decrease in deep-water habitat would be small compared with the overall size of the Laguna, the increase in habitat useful to the shorebird guild is also small considering the vast amount of such habitat in the Laguna. However, the loss of seagrasses by this option and confined placement would probably be the most serious consequences of these two options. This scenario should remove some of the maintenance material from the system, so that the future maintenance frequencies were reduced by 7 percent. Impacts on coastal cabins would be the same as for open-bay confined placement. The construction of open-bay semiconfined placement areas would also displace a water volume that had been available to nekton and plankton.

The areas needed for open-bay semiconfined placement, by reach and placement area are as follows:

Reach 1. This reach contains PAs 175–191. The acreage of each placement area, the emergent land present on each placement area, the maximum acreage required for open-bay semiconfined placement for each placement area, and the amount of additional area that would need to be created, above the emergent land available, is listed below (Table 2-21). Overall, semiconfined placement would require approximately 1,082 acres, if it is assumed that the three levees are built to a total height of 15 feet. Bay impacts would occur from the construction of the additional levees and from runoff from the placement areas. As noted below, no unvegetated bay bottom habitat would be needed for levee creation on PAs 175–184, but a minimum of 852 acres of Laguna bottom would be completely covered for PAs 185–191. Of this total, it is estimated that 767 acres would be seagrass and 85 acres would be unvegetated bay bottom. There are 42 coastal cabins on existing placement areas in Reach 1. However, due to the large amount of emergent area available, it appears that only four of them would be affected by construction of open-bay semiconfined placement areas. Additionally, piping plovers were found on six placement areas in Reach 1 (EH&A, 1993). However, due to the amount of available emergent area versus the much smaller amount of area needed for semiconfined placement, it would appear that none of these sites will be impacted. There would be 1,376 dredging/construction days and 10,320 pipeline-mile days for Reach 1 over the 50-year period.

TABLE 2-21

ACREAGE BY PLACEMENT AREA FOR SEMICONFINED OPEN-BAY PLACEMENT FOR REACH 1

PA	Total Area	Emergent Area	Area Required for Semiconfined Placement	Additional Area Required
175	29.1	28.4	0.0*	0
176	133.8	113.4	10.9	0
177	35.8	27.0	6.3	0
178	125.3	78.6	16.4	0
179	40.1	23.9	5.5	0
180	125.6	76.1	46.5	0
181	96.6	58.9	35.5	0
182	58.5	36.5	17.3	0
183	152.1	59.3	24.4	0
184	98.7	43.9	30.3	0
185	105.4	33.6	46.3	12.7
186	117.4	2.4	98.3	95.9
187	137.8	0.0	188.0	188.0
188	165.8	0.0	213.8	213.8
189	124.7	0.0	174.3	174.3
190	69.9	0.0	101.7	101.7
191	57.3	0.0	65.9	65.9
Total	1,673.9	582.0	1,081.5	852.2

* Never used.

Reach 2. This reach contains PAs 192–202. For this reach, the same information as for Reach 1 is provided below (Table 2-22). Overall, semiconfined placement would require approximately 1,646 acres, if it is assumed that the three levees are built to a total height of 15 feet. Bay impacts would occur from the construction of the additional levees and from runoff from the placement areas. A minimum of 1,335 acres of Laguna bottom would be completely covered to create the semiconfined placement areas. Of this, it is estimated that 648 acres would be seagrass and 687 acres would be unvegetated bay bottom. There are 33 coastal cabins on existing placement areas in Reach 2, all of which would be demolished with the construction of open-bay semiconfined placement areas. Piping plovers were found on two placement areas in Reach 2 (EH&A, 1993), and it would appear that all of that habitat would be covered by creation of the open-bay semiconfined placement areas. There would be 1,681 dredging/construction days and 13,616 pipeline-mile days for Reach 2 over the 50-year period.

TABLE 2-22

ACREAGE BY PLACEMENT AREA FOR SEMICONFINED OPEN-BAY PLACEMENT FOR REACH 2

PA	Total Area	Emergent Area	Area Required for Semiconfined Placement	Additional Area Required
192	90.6	0.0	57.3	57.3
193	90.6	38.0	58.8	20.8
194	121.5	24.6	80.8	56.2
195	103.0	0.3	73.6	73.39
196	103.0	41.2	54.2	13.0
197	304.4	80.4	369.1	288.7
198	146.2	0.0	181.8	181.8
199	124.9	0.0	184.3	184.3
200	196.2	5.1	183.0	177.9
201	173.7	0.0	198.3	198.3
202	195.6	121.1	204.5	83.4
Total	1,649.7	310.7	1,645.6	1,334.9

Reach 3. This reach contains PAs 203–210, all in the Land Cut (Table 2-23). Overall, semiconfined placement would require approximately 974 acres, if it is assumed that the three levees are built only to a total height of 15 feet. Substantial bay impacts would occur since, to achieve open-bay confined placement in Reach 3, semiconfined areas would have to be created in The Hole, an open-water fishing area east of the northern portion of the Land Cut. Bay impacts would occur from the construction of the additional levees and from runoff from the placement areas. A minimum of 974 acres of Laguna bottom, including an estimated 633 acres of seagrass and 341 acres of algal/sand flats, would be completely covered to create the semiconfined placement areas. Channels would have to be dredged into The Hole to provide access for equipment for levee construction. There are 38 coastal cabins on existing placement areas in Reach 3, but none would be impacted by construction of open-bay semiconfined placement areas. No piping plovers were found in Reach 3 (EH&A, 1993, 1997b). There would be 1,752 dredging/construction days and 24,532 pipeline-mile days for Reach 3 over the 50-year period.

Reach 4. This reach contains PAs 211–222. The same information, as for Reach 1, is provided below (Table 2-24). Overall, semiconfined placement would require approximately 1,807.2 acres, if it is assumed that the three levees are built to a total height of 15 feet. Bay impacts would occur from the construction of the additional levees and from runoff from the placement areas. A minimum of 1,646 acres of Laguna bottom would be completely covered to create the semiconfined placement areas. Of this, it is estimated that 623 acres would be seagrass and 1,023 acres would be unvegetated bay bottom. There are 6 coastal cabins on existing placement areas in Reach 4, all of which would be demolished with the construction of open-bay semiconfined placement areas. No piping plovers were found in Reach 4 (EH&A, 1997b). There would be 2,070 dredging/construction days and 2,418 pipeline-mile days for Reach 4 over the 50-year period.

TABLE 2-23

ACREAGE BY PLACEMENT AREA FOR SEMICONFINED OPEN-BAY PLACEMENT FOR REACH 3

PA	Total Area	Emergent Area	Area Required for Semiconfined Placement	Additional Area Required
203	324.5	311.3	72.1	72.1 *
204	167.7	167.7	35.9	35.9
206	380.4	380.4	130.4	130.4
207	322.2	322.2	191.8	191.8
208	769.0	767.0	415.6	415.6
209	193.4	193.4	48.4	48.4
210	242.8	240.7	80.1	80.1
Total	2,400.0	2,382.7	974.1	974.1

* Emergent areas of existing PAs is not applicable for this reach since all PAs would be moved to The Hole.

TABLE 2-24

ACREAGE BY PLACEMENT AREA FOR SEMICONFINED OPEN-BAY PLACEMENT FOR REACH 4

PA	Total Area	Emergent Area	Area Required for Semiconfined Placement	Additional Area Required
211	140.8	45.4	136.7	91.3
212	192.1	0.0	204.4	204.4
213	191.7	0.0	116.7	116.7
214	191.4	0.0	157.1	157.1
215	194.1	0.0	176.3	176.3
216	194.7	0.0	75.5	75.5
217	193.3	0.0	116.2	116.2
218	194.3	0.0	208.9	208.9
219	119.8	0.0	93.7	93.7
220	216.1	2.0	128.5	128.5
221	387.2	63.3	247.3	184.0
222	259.4	52.6	145.9	93.3
Total	2,474.9	161.3	1,807.2	1,645.9

Reach 5. This reach contains PAs 223–228. The same information, as for Reach 1, is provided below (Table 2-25). Overall, semiconfined placement would require approximately 240 acres, if it is assumed that the three levees are built to a total height of 15 feet. Bay impacts would occur from the construction of the additional levees and from runoff from the placement areas. No acres of Laguna bottom would be covered to create the semiconfined placement areas. There are 14 coastal cabins on existing placement areas in Reach 5. However, due to the large amount of emergent area available, it appears that none of them would be affected by construction of open-bay semiconfined placement areas. No piping plovers were found in Reach 5 (EH&A, 1997b). There would be 223 dredging/ construction days and 1,337 pipeline-mile days for Reach 5.

TABLE 2-25

ACREAGE BY PLACEMENT AREA FOR SEMICONFINED OPEN-BAY PLACEMENT FOR REACH 5

PA	Total Area	Emergent Area	Area Required for Semiconfined Placement	Additional Area Required
223	158.8	137.4	41.4	0.0
224	175.4	172.3	15.2	0.0
225	84.3	77.6	8.3	0.0
226	257.6	247.6	85.4	0.0
227	65.4	43.0	38.3	0.0
228	294.4	115.1	51.6	0.0
Total	1,035.9	793.0	240.2	0.0

Reach 6. This reach contains PAs 229–239. The same information, as for Reach 1, is provided below (Table 2-26). Overall, semiconfined placement would require roughly 1,338 acres, if it is assumed that the levees are built to a total height of 15 feet. Bay impacts would occur from the construction of the additional levees and from runoff from the placement areas. Except for PAs 233 and 234, minimal unvegetated bay bottom would be impacted to create the semiconfined, open-bay placement areas, but a minimum of 1,251 acres of Laguna bottom would be completely covered if PAs 233 and 234 are included. As past experience has shown, even if it were found desirable, creating open-bay, semiconfined placement areas at PAs 233 and 234 could be a difficult task. Of the total acres, it is estimated that 500 would be seagrass and 751 would be unvegetated bay bottom. There are 11 coastal cabins on existing placement areas in Reach 6. However, due to the large amount of emergent area available, it appears that none of them would be affected by construction of open-bay semiconfined placement areas. No piping plovers were found in Reach 6 (EH&A, 1997b). There would be 472 dredging/ construction days and 3,305 pipeline-mile days for Reach 6.

TABLE 2-26

ACREAGE BY PLACEMENT AREA FOR SEMICONFINED OPEN-BAY PLACEMENT FOR REACH 6

PA	Total Area	Emergent Area	Area Required for Semiconfined Placement	Additional Area Required
229	129.2	50.4	8.5	0.0
230	82.5	46.5	4.7	0.0
231	127.8	67.0	7.1	0.0
232	127.4	52.5	57.5	5.0
233	210.0	14.7	747.3	732.6
234	121.6	0.0	455.3	455.3
235	121.6	0.0	18.6	18.6
236	129.1	0.0	0.1	0.1
239	49.38	0.0	39.1	39.1
Total	1,098.6	231.1	1,338.2	1,250.7

2.10 RESULTS OF THE MATRIX ANALYSIS

A summary of the information used and the point values assigned are summarized below. As noted in Section 2.8.1, all point values are based on comparisons relative to the impacts of the present practice.

2.10.1 Reach 1

The discussion in this section is based on the scoring criteria presented in Section 2.8.2. The results of the Matrix are summarized in Table 2-27.

2.10.1.1 Dredging Action

The Dredging Action column is based on the acres of the receptors, except for Water Column Effects and Human Uses. Since all maintenance dredging occurs in the GIWW, no acres of any receptor are impacted and therefore, the score for all options is 0. For Water Column Impacts, the turbidity and toxicity effects, if there were any, would be the same for all options during the dredging phase and all scores are 0.

Human Use impacts are based on the number of dredging/construction days, which is 423 for the present practice, Open-Bay Unconfined (OBUn). For Open-Bay Confined (OBC – 654 days or 231 > OBUn) and Open-Bay Semiconfined (OBSC – 615 days or 192 > OBUn), the number of days is within the range of 101 to 500 greater than OBUn, leading to scores of –1. For Upland Confined (UpC – 926 days or 503 days > OBUn) and Upland Thin Layer (UpTL – with the same numbers), the number of

TABLE 2-27

MATRIX SUMMARY FOR REACH 1

Receptor	Option	Action: Dredging Impact	Dredging Score	Conveyance Impact	Conveyance Score	Placement Impact	Placement Score	Post-placement Impact	Post-placement Score	Total Score
Seagrass	OBUn	0 ac	0.0	0 ac	0.0	711 ac	0.0	178 Long term ac 0 20% isopleth ac	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	570 ac	2.0	570 Permanent ac 0 20% isopleth ac	-1.0	**1.0**
	OBSC	0 ac	0.0	0 ac	0.0	617 ac	1.0	617 Permanent ac 0 20% isopleth ac	-1.0	**0.0**
	UpC	0 ac	0.0	23 ac	-1.0	0 ac	2.0	23 Long term ac 0 20% isopleth ac	1.0	**2.0**
	UpTL	0 ac	0.0	23 ac	-1.0	0 ac	2.0	23 Long term ac 0 20% isopleth ac	1.0	**2.0**
	OcnP	0	0.0	61 ac	-1.0	0 ac	2.0	61 Long term ac 0 20% isopleth ac	1.0	**2.0**
Open-Bay Bottom	OBUn	0 ac	0.0	0 ac	0.0	79 ac	0.0	0 * ac	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	63 ac	1.0	63 Permanent ac	-1.0	**0.0**
	OBSC	0 ac	0.0	0 ac	0.0	68 ac	1.0	68 Permanent ac	-1.0	**0.0**
	UpC	0 ac	0.0	28 ac	-1.0	0 ac	1.0	28 Long term ac	-1.0	**-1.0**
	UpTL	0 ac	0.0	28 ac	-1.0	0 ac	1.0	28 Long term ac	-1.0	**-1.0**
	OcnP	0 ac	0.0	75 ac	-1.0	0 ac	1.0	75 Long term ac	-1.0	**-1.0**
* Benthos recover rapidly except very near PA										
Emergent Bay Habitat	OBUn	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 ac, 0 PP**	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 ac, 0 PP	0.0	**0.0**
	OBSC	0 ac	0.0	0 ac	0.0	0 ac	0.0	Temp creation, 0 PP	0.5	**0.5**
	UpC	0 ac	0.0	40 ac	-1.0	0 ac	0.0	40 Long term ac, 0 PP	-0.5	**-1.5**
	UpTL	0 ac	0.0	40 ac	-1.0	0 ac	0.0	40 Long term ac, 0 PP	-0.5	**-1.5**
	OcnP	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 ac, 0 PP	0.0	**0.0**
** Piping Plover Sites										
Terrestrial Habitat	OBUn	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 ac	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	0 ac	0.0	Temp creation	1.0	**1.0**
	OBSC	0 ac	0.0	0 ac	0.0	0 ac	0.0	Temp creation	1.0	**1.0**
	UpC	0 ac	0.0	12 ac	-1.0	516 ac	-2.0	516 Permanent ac	-2.0	**-5.0**
	UpTL	0 ac	0.0	12 ac	-1.0	790 ac	-2.0	790 Improvement ac	2.0	**-1.0**
	OcnP	0 ac	0.0	59 ac	-1.0	0 ac	0.0	0 ac	0.0	**-1.0**
Water Column Effect	OBUn	0 ac	0.0	No booster channels	0.0	Turbidity, no volume loss	0.0	No long-term turbidity	0.0	**0.0**
	OBC	0 ac	0.0	No booster channels	0.0	No turbidity, volume loss	0.0	Reduce turbidity	0.0	**0.0**
	OBSC	0 ac	0.0	No booster channels	0.0	Turbidity, volume loss	-0.5	No long-term turbidity	0.0	**-0.5**
	UpC	0 ac	0.0	Booster channels	-1.0	No turbidity, no volume loss	0.5	Reduce turbidity	0.0	**-0.5**
	UpTL	0 ac	0.0	Booster channels	-1.0	No turbidity, no volume loss	0.5	Reduce turbidity	0.0	**-0.5**
	OcnP	0 ac	0.0	Booster channels	-1.0	Transfer turbidity, no volume loss	0.0	Reduce turbidity	0.0	**-1.0**
Human Uses	OBUn	423 days	0.0	423 pmd[a]	0.0	0 ac	0.0	Minimal TSS, 0 CC[b], no LTA[c]	0.0	**0.0**
	OBC	654 days	-1.0	4,904 pmd	-2.0	633 ac	-2.0	No TSS, 4 CC, no LTA	-0.3	**-5.3**
	OBSC	615 days	-1.0	4,615 pmd	-2.0	685 ac	-2.0	Minimal TSS, 4 CC, no LTA	-0.3	**-5.3**
	UpC	926 days	-2.0	6,483 pmd	-2.0	516 ac	-2.0	No TSS, 0 CC, LTA	-0.3	**-6.3**
	UpTL	926 days	-2.0	6,483 pmd	-2.0	790 ac	-2.0	No TSS, 0 CC, no LTA	0.0	**-6.0**
	OcnP	2,538 days	-3.0	93,923 pmd	-3.0	0 ac	0.0	No TSS, 0 CC, no LTA	0.0	**-6.0**

[a] pipeline-mile-days; [b] Coastal Cabins; [c] Long-term aesthetic effect

days is within the range of 501 to 1,000 greater than OBUn, leading to scores of –2. Ocean Placement by Pipeline (OcnP – 2,538 days) requires over 1,000 days more than OBUn, leading to a score of –3.

2.10.1.2 Conveyance Action

The Conveyance Action column is also based on the acres of the receptors, except for Water Column Effects and Human Uses. For all of the acre receptors (Seagrass, Open-Bay Bottom, Emergent Bay Habitat, Terrestrial Habitat), except Emergent Bay Habitat for OcnP, there are impacts from laying pipelines and dredging booster channels, which fall into the 1-to-100-acre range, leading to scores of –1. There are no water column effects from the other options, relative to the present practice, OBUn, except for those associated with the booster channel dredging for UpC, UpTL, and OcnP, which lead to scores of –1 for these three options. Except for OcnP, in Human Uses, with over 90,000 pipeline-man-days (pmd) and score of –3, the other options have more pmds than OBUn in the range of 2,501–10,000, generating scores of –2.

2.10.1.3 Placement Action

The Placement Action column is also based on the acres of the receptors, except for Water Column Effects and Human Uses. The guidance given in Section 2.8.2 and the fact that all options impact the same or fewer acres than does OBUn, lead to neutral or positive scores for Seagrass, Open-Bay Bottom, and Emergent Bay Habitats. UpC and UpTL impact 516 and 790 more acres of Terrestrial Habitat, respectively, than does OBUn, leading to scores of –2.

As noted in Section 2.8.2, no scores were based on toxicants in the elutriate, because there has been no evidence of problems since 1986. Therefore, only the reduction in turbidity, associated with OBC, UpC, and UpTL and the loss of water volume for plankton and nekton, associated with the creation of OBC and OBSC placement areas, led to Water Quality scoring. There is some turbidity associated with OBUn and OBSC, so the reduction of turbidity for UpC and UpTL led to partial scores of +1, while OcnP, by merely changing the location of the turbidity from the Laguna Madre to the Gulf, and OBSC received partial scores of 0. OBC and OBSC, which caused a volume loss for aquatic flora and fauna, received partial scores of –1, while UpC, UpTL, and OcnP, which caused no volume loss, received partial scores of 0. The averages of the partial scores are presented in Table 2-27.

Human Uses Impacts, for the Placement Action, were determined by the number of acres removed from existing uses by placement. The existing placement areas have been designated for OBUn, so OBUn removes 0 acres from existing practice. OBC and OBSC remove 633 and 685 acres of the Laguna Madre, respectively, from existing uses of fishing, boating, etc., leading to scores of –2 for being in the 101–1,000 acres-more-than-present-practice category. UpC and UpTL were also in this category, for the removal of Terrestrial Habitat from customary use, and also received scores of –2. Actual placement, by the OcnP option, should cause no Human Use impacts and a score of 0 was assigned to this option.

2.10.1.4 Post-Placement Action

The Post-Placement Action is a little more complicated because, as can be seen from Table 2-27, there are more types of impacts per receptor than for the other actions. For example, there is burial of 711 acres of seagrass by OBUn, but there is empirical evidence (Sheridan, 1999) that recovery occurs over 75 percent of this area between dredging cycles, so 25 percent of this, or 178 acres, is considered a long-term loss. OBC and OBSC, on the other hand, lead to permanent loss of seagrasses of 570 and 617 acres of seagrass, respectively, leading to partial scores of –2. The acres of seagrass lost to the booster pump channels for UpC and UpTL are less than the long-term acreage for OBUn, but are also long-term losses and probably permanent. Therefore, there is a gain in the 1-to-100-acre scoring range, leading to partial scores of +1 when UpC, UpTL, and OcnP are compared with OBUn. The computer model showed 0 acre between the isopleths for 20 percent irradiance reaching the seagrasses, with and without OBUn, and none would be expected for the other placement options. Therefore, all partial scores for irradiance are 0. The averages of the partial scores for direct impacts to seagrass and the indirect impacts, via irradiance, are presented in Table 2-27.

Research has shown that benthos recover rapidly, except in the immediate vicinity of the placement area (Sheridan, 1999). Therefore, the area of impact for post-placement for OBUn is not enough to change the permanent or long-term impacts of the other options from the 1-to-100-acre scoring range and all other options received a score of –1 for the Open-Bay Bottom receptor.

OBSC will allow temporary creation of Emergent Bay Habitat from Seagrass and Open-Bay Bottom and received a partial score of +1 for Emergent Bay Habitat, while UpC and UpTL each cause a long-term loss of 40 acres and received a partial score of –1. OBC and OcnP affected 0 acres of Emergent Bay Habitat, leading to partial scores of 0. No piping plover sites are impacted by any option, leading to partial scores of 0. Averages of the partial scores for each option are presented in Table 2-27.

OBC and OBSC will allow temporary creation of Terrestrial Habitat for scores of +1. UpC will permanently remove 516 acres of Terrestrial Habitat from customary usage for a –2, whereas UpTL should improve 790 acres (see Section 2.9.3.2) for a +2.

All Water Column scores are 0 since, while there is turbidity associated with OBUn, the seagrass model showed no long-term difference between the with- and without-placement scenarios and the sediment transport model showed a sharp decrease in the difference between the with- and without-placement turbidity within a few months. Therefore, the fact that some other options reduce that turbidity is not a quantifiable benefit.

For impacts to Human Uses, all of the options produce minimal to no TSS, according to the models, so the only scoring comes from the long-term aesthetic (LTA) impact of 292 acres of Upland Confined placement areas to a height of 32 feet and the loss of four coastal cabins from the OBC and OBSC options. For OBC, a partial score of 0, for no TSS, averaged with a partial score of –1, for the loss of four coastal cabins, and a 0 for no LTA impacts, leads to a final score of –0.3. The same is true for OBSC. For UpC, a partial score of 0, for no TSS, averaged with a partial score of 0 for the loss of no coastal cabins and a –1 for LTA impacts, also leads to a final score of –0.3. UpTL and OcnP generate no TSS, impact no coastal cabins, and have no LTA impacts, leading to final scores of 0.0.

2.10.2 Reach 2

The discussion in this section is based on the scoring criteria presented above in Section 2.8.2. The results of the Matrix are summarized in Table 2-28.

2.10.2.1 Dredging Action

The Dredging Action column is based on the acres of the receptors, except for Water Column Effects and Human Uses. Since all dredging occurs in the GIWW, no acres of any receptor are impacted and, therefore, the score for all options is 0. For Water Column Impacts, the turbidity and toxicity effects, if there are any, would be the same for all options during the dredging phase, and all scores are 0. Human Use impacts are based on the number of dredging/construction days, which is 808 for the present practice, OBUn. For OBC (1,058 days or 250 > OBUn) and OBSC (1,038 days or 230 > OBUn), the number of days is within the range of 101 to 500 greater than OBUn, leading to scores of –1. For UpC and UpTL (both 1,538 days or 730 > OBUn), the number of days is within the range of 501 to 1,000 greater than OBUn, leading to scores of –2.

2.10.2.2 Conveyance Action

The Conveyance Action column is also based on the acres of the receptors, except for Water Column Effects and Human Uses. For all of the acre receptors, there are impacts from laying pipelines and dredging booster channels, which fall into the 1 – 100 range, leading to scores of –1. There are no water column effects from the other options, relative to the present practice, OBUn, except for those associated with the booster channel dredging for UpC and UpTL, which leads to a score of –1 for these two options. For Human Uses, all options have more pmds than OBUn in the range of 2,501–10,000, generating scores of –2.

2.10.2.3 Placement Action

The Placement Action column is also based on the acres of the receptors, except for Water Column Effects and Human Uses. The guidance given in Section 2.8.2 and the fact that all options impact the same or fewer acres than does OBUn, lead to neutral or positive scores for Seagrass, Open-Bay Bottom, and Emergent Bay Habitats. UpC and UpTL impact 980 and 1,651 more acres of Terrestrial Habitat, respectively, than does OBUn, leading to scores of –2 and –3, respectively.

As noted in Section 2.8.2, no scores were based on toxicants in the elutriate because there has been no evidence of problems since 1986. Therefore, only the reduction in turbidity, associated with OBC, UpC, and UpTL and the loss of water volume for plankton and nekton, associated with the creation of OBC and OBSC placement areas, led to Water Quality scoring. There is some turbidity associated with OBUn and OBSC (partial score of 0), so the reduction of turbidity for UpC and UpTL led to partial scores of +1. OBC and OBSC, which caused a volume loss for aquatic flora and fauna, received

TABLE 2-28

MATRIX SUMMARY FOR REACH 2

Receptor	Option	Dredging Impact	Dredging Score	Conveyance Impact	Conveyance Score	Placement Impact	Placement Score	Post-placement Impact	Post-placement Score	Total Score
Seagrass	OBUn	0 ac	0.0	0 ac	0.0	802 ac	0.0	201 Long term ac 80 20% isopleth ac	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	681 ac	2.0	681 Permanent ac 0 20% isopleth ac	-0.5	**1.5**
	OBSC	0 ac	0.0	0 ac	0.0	749 ac	1.0	749 Permanent ac 0 20% isopleth ac	-0.5	**0.5**
	UpC	0 ac	0.0	8 ac	-1.0	0 ac	2.0	8 Long term ac 0 20% isopleth ac	1.5	**2.5**
	UpTL	0 ac	0.0	8 ac	-1.0	0 ac	2.0	8 Long term ac 0 20% isopleth ac	1.5	**2.5**
	OcnP									**N/A**
Open-Bay Bottom	OBUn	0 ac	0.0	0 ac	0.0	849 ac	0.0	0 * ac	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	721 ac	2.0	721 Permanent ac	-2.0	**0.0**
	OBSC	0 ac	0.0	0 ac	0.0	793 ac	1.0	793 Permanent ac	-2.0	**-1.0**
	UpC	0 ac	0.0	18 ac	-1.0	0 ac	2.0	18 Long term ac	-1.0	**0.0**
	UpTL	0 ac	0.0	18 ac	-1.0	0 ac	2.0	18 Long term ac	-1.0	**0.0**
	OcnP									**N/A**
* Benthos recover rapidly except very near PA										
Emergent Bay Habitat	OBUn	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 ac, 0 PP**	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 ac, 2 PP	-0.5	**-0.5**
	OBSC	0 ac	0.0	0 ac	0.0	0 ac	0.0	Temp creation, 2 PP	0.0	**0.0**
	UpC	0 ac	0.0	10 ac	-1.0	0 ac	0.0	10 Long term ac, 0 PP	-0.5	**-1.5**
	UpTL	0 ac	0.0	10 ac	-1.0	0 ac	0.0	10 Long term ac, 0 PP	-0.5	**-1.5**
	OcnP									**N/A**
** Piping Plover Sites										
Terrestrial Habitat	OBUn	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 ac	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	0 ac	0.0	Temp creation	1.0	**1.0**
	OBSC	0 ac	0.0	0 ac	0.0	0 ac	0.0	Temp creation	1.0	**1.0**
	UpC	0 ac	0.0	1 ac	-1.0	980 ac	-2.0	980 Permanent ac	-2.0	**-5.0**
	UpTL	0 ac	0.0	1 ac	-1.0	1,651 ac	-3.0	1,651 Improvement ac	3.0	**-1.0**
	OcnP									**N/A**
Water Column Effect	OBUn	0 ac	0.0	No booster channels	0.0	Turbidity, no volume loss	0.0	No long-term turbidity	0.0	**0.0**
	OBC	0 ac	0.0	No booster channels	0.0	No turbidity, volume loss	0.0	Reduce turbidity	0.0	**0.0**
	OBSC	0 ac	0.0	No booster channels	0.0	Turbidity, volume loss	-0.5	No long-term turbidity	0.0	**-0.5**
	UpC	0 ac	0.0	Booster channels	-1.0	No turbidity, no volume loss	0.5	Reduce turbidity	0.0	**-0.5**
	UpTL	0 ac	0.0	Booster channels	-1.0	No turbidity, no volume loss	0.5	Reduce turbidity	0.0	**-0.5**
	OcnP									**N/A**
Human Uses	OBUn	808 days	0.0	808 pmd[a]	0.0	0 ac	0.0	Minimal TSS, 0 CC[b], no LTA[c]	0.0	**0.0**
	OBC	1,058 days	-1.0	8,567 pmd	-2.0	1,402 ac	-3.0	No TSS, 33 CC, no LTA	-0.7	**-6.7**
	OBSC	1,038 days	-1.0	8,412 pmd	-2.0	1,542 ac	-3.0	Minimal TSS, 33 CC, no LTA	-0.7	**-6.7**
	UpC	1,538 days	-2.0	10,767 pmd	-2.0	980 ac	-2.0	No TSS, 0 CC, LTA	-0.3	**-6.3**
	UpTL	1,538 days	-2.0	10,767 pmd	-2.0	1,651 ac	-3.0	No TSS, 0 CC, no LTA	0.0	**-7.0**
	OcnP									**N/A**

a pipeline-mile-days; b Coastal Cabins; c Long-term aesthetic effect partial scores of –1, while UpC, UpTL, and OcnP, which caused no volume loss, received partial scores of 0. The averages of the partial scores are presented in Table 2-28.

Human Uses impacts, for the Placement Action, were determined by the number of acres removed from existing uses by placement. The existing placement areas have been designated for OBUn, so OBUn removes 0 acres from existing practice. OBC and OBSC remove 1,402 and 1,542 acres of the Laguna Madre, respectively, from existing uses of fishing, boating, etc., leading to scores of –3 for being in the >1,000 acre category. UpTL was also in this category, for the removal of 1,651 acres of Terrestrial Habitat from customary use, while UpC removes 980 acres and received a score of –2.

2.10.2.4 Post-Placement Action

The Post-Placement Action is a little more complicated because, as can be seen from Table 2-28, there are more types of impacts per receptor than for the other actions. For example, there is burial of 802 acres of seagrass by OBUn, but there is empirical evidence (Sheridan, 1999) that recovery occurs over 75 percent of this area between dredging cycles, so 25 percent of this is considered a long-term loss. OBC and OBSC, on the other hand, lead to permanent loss of seagrasses of 681 and 749 acres of seagrass, respectively, leading to partial scores of –2, while UpC and UpTL impacted fewer long-term acres of seagrass (101–1,000 acre category) for partial scores of +2. However, the computer models showed 80 acres between the isopleths for 20 percent irradiance reaching the seagrasses, with and without OBUn. It was assumed that there would be no acreage differences between isopleths for the other options, so they received partial scores of +1, based on the acreage between the isopleths. The average of partial scores of –2 and +1 is –0.5, for OBC and OBSC, and the average of +2 and +1 is +1.5, for UpC and UpTL.

Research has shown that benthos recover rapidly, except in the immediate vicinity of the placement area (Sheridan, 1999). Therefore, the area of impact for post-placement for OBUn is not enough to change the permanent or long-term impacts of the other options and, therefore, UpC and UpTL received a score of –1 for the Open-Bay Bottom receptor, while OBC and OBSC received scores of –2.

OBC affected 0 acres of Emergent Bay Habitat, but led to the loss of two piping plover sites, leading to a final average of –0.5. OBSC will allow temporary creation of Emergent Bay Habitat from Seagrass and Open-Bay Bottom and received a partial score of +1. However, OBSC also led to a loss of two piping plover sites for a partial score of –1 for piping plover sites, and a final score of 0 for Emergent Bay Habitat. UpC and UpTL each cause a long-term loss of 10 acres of Emergent Bay Habitat, while affecting no piping plover sites, for a final score of –0.5 (average of –1 and 0).

OBC and OBSC will allow temporary creation of Terrestrial Habitat for scores of +1. UpC will permanently remove 980 acres of Terrestrial Habitat from customary usage for a –2, whereas UpTL should improve 1,651 acres (see Section 2.9.3.2) for a +3.

All Water Column scores are 0 since, while there is turbidity associated with OBUn, the seagrass model showed no long-term difference between the with- and without-placement scenarios and the sediment transport model showed a sharp decrease in the difference between the with- and without-placement turbidity within a few months. Therefore, the fact that some other options reduce that turbidity is not a quantifiable benefit.

For impacts to Human Uses, all of the options produce minimal to no TSS, according to the models, so the only scoring comes from the long-term aesthetic (LTA) impact of 980 acres of Upland Confined placement areas to a height of 32 feet and the loss of 33 coastal cabins from the OBC and OBSC options. For OBC, a partial score of 0, for no TSS, averaged with a partial score of –2, for the loss of 33 coastal cabins, and 0 for no LTA impacts, leads to a final score of –0.7. The same is true for OBSC. For UpC, a partial score of 0, for no TSS, averaged with a partial score of 0, for the loss of no coastal cabins, and –1 for LTA impacts, leads to a final score of –0.3. UpTL generates no TSS, impacts no coastal cabins, and has no LTA impacts, leading to a final score of 0.0.

2.10.3 Reach 3

The discussion in this section is based on the scoring criteria presented above in Section 2.8.2. The results of the Matrix are summarized in Table 2-29.

2.10.3.1 Dredging Action

The Dredging Action column is based on the acres of the receptors, except for Water Column Effects and Human Uses. Since all dredging occurs in the GIWW, no acres of any receptor are impacted and therefore, the score for all options is 0. For Water Column Impacts, the turbidity and toxicity effects, if there are any, would be the same for all options during the dredging phase, and all scores are 0. Human Use impacts are based on the number of dredging/construction days which is 528 for the present practice, UpC. UpTL is not feasible for this reach (Section 2.9.3.2). For the three remaining options, OBUn, OBC, and OBSC, the number of days required for dredging and construction in the range of 501 to 1,000 greater than UpC, leading to scores of –2.

2.10.3.2 Conveyance Action

The Conveyance Action column is also based on the acres of the receptors, except for Water Column Effects and Human Uses. Since upland areas, designated as placement areas, occur adjacent to the GIWW in Reach 3, the impacts from laying pipelines and dredging booster channels to seagrasses, open-bay bottom, and emergent bay habitat, that are found in the other reaches, do not occur in Reach 3. Therefore, the acreages and scores are 0 for conveyance for these receptors. There are no water column effects from the other options, relative to the present practice, UpC, since all boosters will be located on uplands, which leads to a score of 0 for all of these options. For Human Uses, the other options have over 10,000 more pmds than UpC, generating scores of –3.

2.10.3.3 Placement Action

The Placement Action column is also based on the acres of the receptors, except for Water Column Effects and Human Uses. The guidance given in Section 2.8.2 and the fact that all options impact between 100 – 1,000 more acres of Seagrass and Emergent Bay Habitat than does UpC, lead to

TABLE 2-29

MATRIX SUMMARY FOR REACH 3

Receptor	Option	Action: Dredging Impact	Dredging Score	Conveyance Impact	Conveyance Score	Placement Impact	Placement Score	Post-placement Impact	Post-placement Score	Total
Seagrass	OBUn	0 ac	0.0	0 ac	0.0	630 ac	-2.0	158 Long term ac 0 20% isopleth ac	-1.0	**-3.0**
	OBC	0 ac	0.0	0 ac	0.0	770 ac	-2.0	770 Permanent ac 0 20% isopleth ac	-1.0	**-3.0**
	OBSC	0 ac	0.0	0 ac	0.0	793 ac	-2.0	793 Permanent ac 0 20% isopleth ac	-1.0	**-3.0**
	UpC	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 Long term ac 0 20% isopleth ac	0.0	**0.0**
	UpTL									**N/A**
	OcnP									**N/A**
Open-Bay Bottom	OBUn	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 * ac	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 Permanent ac	0.0	**0.0**
	OBSC	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 Permanent ac	0.0	**0.0**
	UpC	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 Long term ac	0.0	**0.0**
	UpTL									**N/A**
	OcnP									**N/A**
* Benthos recover rapidly except very near PA										
Emergent Bay Habitat	OBUn	0 ac	0.0	0 ac	0.0	340 ac	-2.0	0 ac, 0 PP**	0.0	**-2.0**
	OBC	0 ac	0.0	0 ac	0.0	415 ac	-2.0	0 ac, 0 PP	0.0	**-2.0**
	OBSC	0 ac	0.0	0 ac	0.0	427 ac	-2.0	Temp creation, 0 PP	0.5	**-1.5**
	UpC	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 Long term ac, 0 PP	0.0	**0.0**
	UpTL									**N/A**
	OcnP									**N/A**
** Piping Plover Sites										
Terrestrial Habitat	OBUn	0 ac	0.0	0 ac	0.0	0 ac	2.0	0 ac	0.0	**2.0**
	OBC	0 ac	0.0	0 ac	0.0	0 ac	2.0	Temp creation	1.0	**3.0**
	OBSC	0 ac	0.0	0 ac	0.0	0 ac	2.0	Temp creation	1.0	**3.0**
	UpC	0 ac	0.0	0 ac	0.0	776 ac	0.0	0 Permanent ac	0.0	**0.0**
	UpTL									**N/A**
	OcnP									**N/A**
Water Column Column Effect	OBUn	0 ac	0.0	No booster channels	0.0	Turbidity, no volume loss	-0.5	No long-term turbidity	0.0	**-0.5**
	OBC	0 ac	0.0	No booster channels	0.0	No turbidity, volume loss	-0.5	Reduce turbidity	0.0	**-0.5**
	OBSC	0 ac	0.0	No booster channels	0.0	Turbidity, volume loss	-1.0	No long-term turbidity	0.0	**-1.0**
	UpC	0 ac	0.0	No booster channels	0.0	No turbidity, no volume loss	0.0	Reduce turbidity	0.0	**0.0**
	UpTL									**N/A**
	OcnP									**N/A**
Human Uses	OBUn	1,227 days	-2.0	17,182 pmd[a]	-3.0	243 ac	-2.0	Minimal TSS, 0 CC[b], no LTA[c], no impacts to the Hole	0.0	**-7.0**
	OBC	1,136 days	-2.0	15,909 pmd	-3.0	1,185 ac	-3.0	No TSS, 0 CC, no LTA, impacts to The Hole	-0.3	**-8.3**
	OBSC	1,045 days	-2.0	14,636 pmd	-3.0	1,220 ac	-3.0	Minimal TSS, 0 CC, no LTA, impacts to The Hole	-0.3	**-8.3**
	UpC	528 days	0.0	528 pmd	0.0	0 ac	0.0	No TSS, 0 CC, no LTA, no impacts to The Hole	0.0	**0.0**
	UpTL									**N/A**
	OcnP									**N/A**

[a] pipeline-mile-days; [b] Coastal Cabins; [c] Long-term aesthetic effect

scores of –2 for these receptors. No Open-Bay Bottom is affected by any option and the scores are 0. UpC impacts 776 acres of Terrestrial Habitat, while the other options affect none, leading to scores of +2 for all other options.

As noted in Section 2.8.2, no scores were based on toxicants in the elutriate because there was no evidence of problems since 1986. Therefore, only the increase in turbidity associated with OBSC and OBUn (partial score of –1) and the volume loss associated with OBC and OBSC (partial score of –1) led to Water Quality scoring. The average of the partial scores, –0.5, for OBUn and OBC, and –1.0, for OBSC, are included in Table 2-29.

Scores for Human Uses were determined by the number of acres removed from existing uses, by placement. Since the placement areas in Reach 3, where UpC placement would occur have been designated for placement of dredged material, UpC would remove 0 acres from previous usage. OBC and OBSC would remove 1,185 and 1,220 acres of the Laguna Madre, respectively, from existing uses of fishing, boating, etc., leading to scores of –3 for being in the >1,000 acre category. OBUn is estimated to have some impact on 970 acres of Laguna Madre that is used for fishing, boating, etc., 25 percent, or 243 acres, of which is considered long term (see Section 2.9.5.1) leading to a score of –2.

2.10.3.4 Post-Placement Action

The Post-Placement Action is a little more complicated because, as can be seen from Table 2-29, there are more types of impacts per receptor than for the other actions. For example, there is burial of 630 acres of seagrass by OBUn, but there is empirical evidence (Sheridan, 1999) that recovery occurs over 75 percent of this area between dredging cycles, so 25 percent of this is considered a long-term loss. Since UpC impacts no seagrass, OBUn received a partial score of –2. OBC and OBSC, on the other hand, lead to permanent loss of 770 and 793 acres of seagrass, respectively, leading to partial scores of -2. The model provided no information on the acreage difference between the 20 percent irradiance isopleths, with and without placement by OBUn, because OBUn has never been used in this reach and there are no historical data with which to compare. However, based on the high sand content of Reach 3 sediment, it was assumed that OBUn placement in The Hole would lead to essentially no turbidity, and no difference in irradiance acres. Based on the assumption of 0 acres, OBUn would receive a partial score of 0 for irradiance differences. The average of the partial scores of –2 for seagrass acreage and 0 for irradiance, leads to a final score of –1.0 for OBUn, OBC, and OBSC.

Research has shown that benthos recover rapidly, except in the immediate vicinity of the placement area (Sheridan, 1999). Therefore, the area of impact for post-placement for OBUn is not enough to assign a negative score to this option and all options received a score of 0 for Open-Bay Bottom. OBSC will allow temporary creation of Emergent Bay Habitat from Seagrass and Open-Bay Bottom and received a partial score of +1 for Emergent Bay Habitat, while all other options affected no Emergent Bay Habitat and received a partial score of 0. No piping plover sites are impacted by any option, leading to partial scores of 0. Averages of the partial scores for each option are presented in Table 2-29.

UpC will impact 776 acres of Terrestrial Habitat but it has all been designated for that use. OBC and OBSC will allow temporary creation of Terrestrial Habitat from seagrass and Emergent Bay Habitat for scores of +1. OBUn will affect no Terrestrial Habitat for a score of 0.

All Water Column scores are 0 since, while there is turbidity associated with OBUn, the seagrass model showed no long-term difference between the with- and without-placement scenarios, and the sediment transport model showed a sharp decrease in the difference between the with- and without-placement turbidity within a few months for the other reaches. Therefore, the fact that it induces turbidity relative to UpC is not a quantifiable impact.

For impacts to Human Uses, all of the options produce minimal to no TSS, according to the models, so the only scoring comes from the long-term impacts to The Hole by OBC and OBSC (partial score of –1). Since the Upland Confined placement areas are already in existence, there are no long-term aesthetic (LTA) impacts from UpC in Reach 3, as there would be in other reaches. No coastal cabins are impacted by any placement option. Therefore, OBUn and UpC generate no TSS, impact no coastal cabins, have no LTA impacts, and cause no impacts to The Hole for a final score of 0. OBC and OBSC are the same except for impacts to The Hole for final average scores of –0.25, which rounds to –0.3.

2.10.4 Reach 4

The discussion in this section is based on the scoring criteria presented above in Section 2.8.2. The results of the Matrix are summarized in Table 2-30.

2.10.4.1 Dredging Action

The Dredging Action column is based on the acres of the receptors, except for Water Column Effects and Human Uses. Since all dredging occurs in the GIWW, no acres of any receptor are impacted, and therefore, the score for all options is 0. For Water Column Impacts, the turbidity and toxicity effects, if there are any, would be the same for all options during the dredging phase, and all scores are 0. Human Use impacts are based on the number of dredging/construction days, which is 969 for the present practice, OBUn. For OBC (1,594 days or 625 > OBUn) and OBSC (1,500 days or 531 > OBUn), the number of days is within the range of 501 to 1,000 greater than OBUn, leading to scores of –2. For UpC and UpTL (both 2,043 days or 1,074 > OBUn), the number of days is more than1,000 days greater than OBUn, leading to scores of –3.

2.10.4.2 Conveyance Action

The Conveyance Action column is also based on the acres of the receptors, except for Water Column Effects and Human Uses. For all of the acre receptors, there are impacts from laying pipelines and dredging booster channels for UpC and UpTL, which fall into the 1 – 100 range, leading to scores of –1 for these two options. There are no water column effects from the other options, relative to the present practice, OBUn, except for those associated with the booster channel dredging for UpC and UpTL, which leads to a score of –1 for these two options. For Human Uses, OBC and OBSC have more

Table 2-30

Matrix Summary for Reach 4

Receptor	Option	Dredging Impact	Dredging Score	Conveyance Impact	Conveyance Score	Placement Impact	Placement Score	Post-placement Impact	Post-placement Score	Total
		Action								
Seagrass	OBUn	0 ac	0.0	0 ac	0.0	429 ac	0.0	107 Long term ac 131 20% isopleth ac	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	643 ac	-2.0	643 Permanent ac 0 20% isopleth ac	0.0	**-2.0**
	OBSC	0 ac	0.0	0 ac	0.0	699 ac	-2.0	699 Permanent ac 0 20% isopleth ac	0.0	**-2.0**
	UpC	0 ac	0.0	40 ac	-1.0	0 ac	2.0	40 Long term ac 0 20% isopleth ac	1.5	**2.5**
	UpTL	0 ac	0.0	40 ac	-1.0	0 ac	2.0	40 Long term ac 0 20% isopleth ac	1.5	**2.5**
	OcnP									**N/A**
Open-Bay Bottom	OBUn	0 ac	0.0	0 ac	0.0	704 ac	0.0	0 * ac	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	1,056 ac	-2.0	1,056 Permanent ac	-3.0	**-5.0**
	OBSC	0 ac	0.0	0 ac	0.0	1,149 ac	-2.0	1,149 Permanent ac	-3.0	**-5.0**
	UpC	0 ac	0.0	59 ac	-1.0	0 ac	2.0	59 Long term ac	-1.0	**0.0**
	UpTL	0 ac	0.0	59 ac	-1.0	0 ac	2.0	59 Long term ac	-1.0	**0.0**
	OcnP									**N/A**
* Benthos recover rapidly except very near PA										
Emergent Bay Habitat	OBUn	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 ac, 0 PP**	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 ac, 0 PP	0.0	**0.0**
	OBSC	0 ac	0.0	0 ac	0.0	0 ac	0.0	Temp creation, 0 PP	0.5	**0.5**
	UpC	0 ac	0.0	16 ac	-1.0	0 ac	0.0	16 Long term ac, 0 PP	-0.5	**-1.5**
	UpTL	0 ac	0.0	16 ac	-1.0	0 ac	0.0	16 Long term ac, 0 PP	-0.5	**-1.5**
	OcnP									**N/A**
** Piping Plover Sites										
Terrestrial Habitat	OBUn	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 ac	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	0 ac	0.0	Temp creation	1.0	**1.0**
	OBSC	0 ac	0.0	0 ac	0.0	0 ac	0.0	Temp creation	1.0	**1.0**
	UpC	0 ac	0.0	9 ac	-1.0	1,123 ac	-3.0	1,123 Permanent ac	-3.0	**-7.0**
	UpTL	0 ac	0.0	9 ac	-1.0	1,133 ac	-3.0	1,133 Improvement ac	3.0	**-1.0**
	OcnP									**N/A**
Water Column Effects	OBUn	0 ac	0.0	ooster char	0.0	ty, no volu	0.0	No long-term turbidity	0.0	**0.0**
	OBC	0 ac	0.0	ooster char	0.0	No	0.0	Reduce turbidity	0.0	**0.0**
	OBSC	0 ac	0.0	ooster char	0.0	Turbidity,	-0.5	No long-term turbidity	0.0	**-0.5**
	UpC	0 ac	0.0	oster chann	-1.0	No	0.5	Reduce turbidity	0.0	**-0.5**
	UpTL	0 ac	0.0	oster chann	-1.0	No	0.5	Reduce turbidity	0.0	**-0.5**
	OcnP									**N/A**
Human Uses	OBUn	969 days	0.0	969 pmd[a]	0.0	0 ac	0.0	Minimal TSS, 0 CC[b], no LTA[c]	0.0	**0.0**
	OBC	1,594 days	-2.0	9,563 pmd	-2.0	1,699 ac	-3.0	No TSS, 6 CC, no LTA	-0.3	**-7.3**
	OBSC	1,500 days	-2.0	9,000 pmd	-2.0	1,848 ac	-3.0	inimal TSS, 6 CC, no LT	-0.3	**-7.3**
	UpC	2,043 days	-3.0	14,298 pmd	-3.0	1,123 ac	-3.0	No TSS, 0 CC, LTA	-0.3	**-9.3**
	UpTL	2,043 days	-3.0	14,298 pmd	-3.0	1,133 ac	-3.0	No TSS, 0 CC, no LTA	0.0	**-9.0**
	OcnP									**N/A**

[a] pipeline-mile-days; [b] Coastal Cabins; [c] Long-term aesthetic effect

pmds than OBUn in the range of 2,501 – 10,000, generating scores of –2. UpC and UpTL have more than 10,000 pmds greater than OBUn, generating scores of –3 for these two options.

2.10.4.3 Placement Action

The Placement Action column is also based on the acres of the receptors, except for Water Column Effects and Human Uses. OBC and OBSC impact more Seagrass and Open-Bay Bottom than does OBUn, in the range of 100–1,000 acres, leading to scores of –2 for these two options for these two receptors. UpC and UpTL impact no Seagrass or Open-Bay Bottom during placement, so they received scores of +2 for these two receptors. No Emergent Bay Habitat was impacted during placement in Reach 4, so all options received scores of 0. UpC and UpTL impact 1,123 and 1,133 more acres of Terrestrial Habitat, respectively, than does OBUn, leading to scores of –3.

As noted in Section 2.8.2, no scores were based on toxicants in the elutriate because there was no evidence of problems since 1986. Therefore, only the reduction in turbidity, associated with OBC, UpC, and UpTL and the loss of water volume for plankton and nekton, associated with the creation of OBC and OBSC placement areas, led to Water Quality scoring. There is some turbidity associated with OBUn, so the reduction of turbidity for UpC and UpTL led to partial scores of +1. OBC, which reduced turbidity but caused a volume loss for aquatic flora and fauna (partial scores of +1 and –1), received a net score of 0 while OBSC, which caused the volume loss but did not reduce turbidity completely (partial scores of –1 and 0), received an average score of –0.5.

Human Uses impacts, for the Placement Action, were determined by the number of acres removed from existing uses by placement. The existing placement areas have been designated for OBUn, so OBUn removes 0 acres from existing practice. OBC and OBSC remove 1,699 and 1,848 acres of the Laguna Madre, respectively, from existing uses of fishing, boating, etc., leading to scores of –3 for being in the >1,000 acre category. UpC and UpTL were also in this category, for the removal of Terrestrial Habitat (1,133 acres and 1,123 acres, respectively) from customary use.

2.10.4.4 Post-Placement Action

The Post-Placement Action is a little more complicated because, as can be seen from Table 2-30, there are more types of impacts per receptor than for the other actions. For example, there is burial of 429 acres of seagrass by OBUn, but there is empirical evidence (Sheridan, 1999) that recovery occurs over 75 percent of this area between dredging cycles, so 25 percent of this is considered a long-term loss. OBC and OBSC, on the other hand, lead to permanent loss of seagrasses of 643 and 699 acres of seagrass, respectively, leading to partial scores of –2. However, the computer models showed 131 acres between the isopleths for 20 percent irradiance reaching the seagrasses, with and without OBUn. It was assumed that there would be no acreage differences between isopleths for the other options, so OBC and OBSC received partial scores of +2, based on the acreage between the isopleths. The average of partial scores of –2 and +2 is 0. Therefore, OBC and OBSC received final scores of 0.

The acres of seagrass lost to the booster pump channels for UpC and UpTL are less than the long-term acreage for OBUn, and is also long-term loss and probably permanent. Therefore, there is a seagrass gain in the 1-to-100-acre scoring range, leading to partial scores of +1 when UpC and UpTL are compared with OBUn. Averaged with the +2, based on the acreage between the isopleths, leads to final scores of +1.5 for UpC and UpTL.

Research has shown that benthos recover rapidly, except in the immediate vicinity of the placement area (Sheridan, 1999). Therefore, the area of impact for post-placement for OBUn is not enough to change the permanent or long-term impacts of the other options and UpC and UpTL received scores of –1 for the Open-Bay Bottom receptor (booster channels), while OBC and OBSC received scores of –3.

OBSC will allow temporary creation of Emergent Bay Habitat from Seagrass and Open-Bay Bottom and received a partial score of +1. OBC affected 0 acres of Emergent Bay Habitat, leading to a partial score of 0. UpC and UpTL each cause a long-term loss of 16 acres of Emergent Bay Habitat, leading partial scores of –1. No piping plover sites are impacted by any option, leading to partial scores on 0. Averages of the partial scores for each option are presented in Table 2-30.

OBC and OBSC will allow temporary creation of Terrestrial Habitat for scores of +1. UpC will permanently remove 1,123 acres of Terrestrial Habitat from customary usage for a –3, whereas UpTL should improve 1,133 acres (see Section 2.9.3.2) for a +3.

All Water Column scores are 0 since, while there is turbidity associated with OBUn, the seagrass model showed no long-term difference between the with- and without-placement scenarios, and the sediment transport model showed a sharp decrease in the difference between the with- and without-placement turbidity within a few months. Therefore, the fact that some other options reduce that turbidity is not a quantifiable benefit.

For impacts to Human Uses, all of the options produce minimal to no TSS, according to the models, so the only scoring comes from the long-term aesthetic (LTA) impact of 1,123 acres of Upland Confined placement areas, to a height of 33 feet, and the loss of 6 coastal cabins with OBC and OBSC. For OBC, a partial score of 0, for no TSS, averaged with a partial score of –1, for the loss of 6 coastal cabins, and 0 for no LTA impacts, leads to a final score of –0.3. The same is true for OBSC. For UpC, a partial score of 0, for no TSS, averaged with a partial score of 0, for the loss of no coastal cabins, and –1 for LTA impacts, leads to a final score of –0.3. UpTL generates no TSS, impacts no coastal cabins, and has no LTA impacts, leading to a final score of 0.0.

2.10.5 Reach 5

The discussion in this section is based on the scoring criteria presented above in Section 2.8.2. The results of the Matrix are summarized in Table 2-31.

2.10.5.1 Dredging Action

The Dredging Action column is based on the acres of the receptors, except for Water Column Effects and Human Uses. Since all dredging occurs in the GIWW, no acres of any receptor are

Table 2-31

Matrix Summary for Reach 5

Receptor	Option	Action: Dredging Impact	Score	Conveyance Impact	Score	Placement Impact	Score	Post-placement Impact	Score	Total
Seagrass	OBUn	0 ac	0.0	0 ac	0.0	139 ac	0.0	35 Long term ac, 10 20% isopleth ac	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	50 ac	1.0	50 Permanent ac 0 20% isopleth ac	0.0	**1.0**
	OBSC	0 ac	0.0	0 ac	0.0	56 ac	1.0	56 Permanent ac 0 20% isopleth ac	0.0	**1.0**
	UpC	0 ac	0.0	29 ac	-1.0	0 ac	2.0	29 Long term ac 0 20% isopleth ac	1.0	**2.0**
	UpTL	0 ac	0.0	29 ac	-1.0	0 ac	2.0	29 Long term ac 0 20% isopleth ac	1.0	**2.0**
	OcnP	0 ac	0.0	82 ac	-1.0	0 ac	2.0	82 Long term ac 0 20% isopleth ac	0.0	**1.0**
Open-Bay Bottom	OBUn	0 ac	0.0	0 ac	0.0	33 ac	0.0	0 * ac	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	12 ac	1.0	12 Permanent ac	-1.0	**0.0**
	OBSC	0 ac	0.0	0 ac	0.0	14 ac	1.0	14 Permanent ac	-1.0	**0.0**
	UpC	0 ac	0.0	10 ac	-1.0	0 ac	1.0	10 Long term ac	-1.0	**-1.0**
	UpTL	0 ac	0.0	10 ac	-1.0	0 ac	1.0	10 Long term ac	-1.0	**-1.0**
	OcnP	0 ac	0.0	0 ac	0.0	0 ac	1.0	0 Long term ac	0.0	**1.0**
* Benthos recover rapidly except very near PA										
Emergent Bay Habitat	OBUn	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 ac, 0 PP**	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 ac, 0 PP	0.0	**0.0**
	OBSC	0 ac	0.0	0 ac	0.0	0 ac	0.0	Temp creation, 0 PP	0.5	**0.5**
	UpC	0 ac	0.0	30 ac	-1.0	0 ac	0.0	30 Long term ac, 0 PP	-0.5	**-1.5**
	UpTL	0 ac	0.0	30 ac	-1.0	0 ac	0.0	30 Long term ac, 0 PP	-0.5	**-1.5**
	OcnP	0 ac	0.0	72 ac	-1.0	0 ac	0.0	72 ac, 0 PP	-0.5	**-1.5**
** Piping Plover Sites										
Terrestrial Habitat	OBUn	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 ac	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	0 ac	0.0	Temp creation	1.0	**1.0**
	OBSC	0 ac	0.0	0 ac	0.0	0 ac	0.0	Temp creation	1.0	**1.0**
	UpC	0 ac	0.0	0 ac	0.0	176 ac	-2.0	176 Permanent ac	-2.0	**-4.0**
	UpTL	0 ac	0.0	0 ac	0.0	172 ac	-2.0	172 Improvement	2.0	**0.0**
	OcnP	0 ac	0.0	15 ac	-1.0	0 ac	0.0	15 Long term ac	-1.0	**-2.0**
Water Column Effect	OBUn	0 ac	0.0	No booster channels	0.0	Turbidity, no volume loss	0.0	No long-term turbidity	0.0	**0.0**
	OBC	0 ac	0.0	No booster channels	0.0	No turbidity, volume loss	0.0	Reduce turbidity	0.0	**0.0**
	OBSC	0 ac	0.0	No booster channels	0.0	Turbidity, volume loss	-0.5	No long-term turbidity	0.0	**-0.5**
	UpC	0 ac	0.0	Booster channels	-1.0	No turbidity, no volume loss	0.5	Reduce turbidity	0.0	**-0.5**
	UpTL	0 ac	0.0	Booster channels	-1.0	No turbidity, no volume loss	0.5	Reduce turbidity	0.0	**-0.5**
	OcnP	0 ac	0.0	Booster channels	-1.0	Transfer turbidity, no volume loss	0.0	Reduce turbidity	0.0	**-1.0**
Human Uses	OBUn	132 days	0.0	132 pmd[a]	0.0	0 ac	0.0	Minimal TSS, 0 CC[b], no LTA[c]	0.0	**0.0**
	OBC	316 days	-1.0	1,895 pmd	-1.0	62 ac	-1.0	No TSS, 0 CC, no LTA	0.0	**-3.0**
	OBSC	289 days	-1.0	1,737 pmd	-1.0	70 ac	-1.0	Minimal TSS, 0 CC, no LTA	0.0	**-3.0**
	UpC	566 days	-1.0	3,961 pmd	-2.0	176 ac	-2.0	No TSS, 0 CC, LTA	-0.3	**-5.3**
	UpTL	566 days	-1.0	3,961 pmd	-2.0	172 ac	-2.0	No TSS, 0 CC, no LTA	0.0	**-5.0**
	OcnP	1,132 days	-2.0	27,158 pmd	-3.0	0 ac	0.0	No TSS, 0 CC, no LTA	0.0	**-5.0**

[a] pipeline-mile-days; [b] Coastal Cabins; [c] Long-term aesthetic effect

impacted and, therefore, the score for all options is 0. For Water Column Impacts, the turbidity and toxicity effects, if there are any, would be the same for all options during the dredging phase, and all scores are 0. Human Use impacts are based on the number of dredging/construction days, which is 132 for the present practice, OBUn. For OBC (316 days or 184 > OBUn) and OBSC (289 days or 157 > OBUn), the number of days is within the range of 101 to 500 greater than OBUn, leading to scores of –1. For UpC and UpTL (both 566 days or 434 > OBUn), the number of days is also within the range of 101 to 500 greater than OBUn, leading to scores of –1. OcnP (1,132 days) requires exactly 1,000 days more than OBUn, leading to a score of –2.

2.10.5.2 Conveyance Action

The Conveyance Action column is also based on the acres of the receptors, except for Water Column Effects and Human Uses. For all of the acre receptors, there are impacts from laying pipelines and dredging booster channels, which fall into the 1 – 100 range, leading to scores of –1 for UpC, UpTL, and OcnP, for one or more receptors. There are no water column effects from the other options, relative to the present practice, OBUn, except for those associated with the booster channel dredging for UpC, UpTL, and OcnP, which leads to a score of –1 for these three options. For Human Uses, all options have more pmds than OBUn: in the range of 1,000 to 2,500 for OBC and OBSC for scores of –1; between 2,501 – 10,000, for UpC and UpTL, generating scores of –2; and >10,000 for OcnP, leading to a score of –3.

2.10.5.3 Placement Action

The Placement Action column is also based on the acres of the receptors, except for Water Column Effects and Human Uses. The guidance given in Section 2.8.2 and the fact that all options impact the same or fewer acres than does OBUn, lead to neutral or positive scores for Seagrass, Open-Bay Bottom, and Emergent Bay Habitats. UpC and UpTL impact 176 and 172 more acres of Terrestrial Habitat, respectively, than does OBUn, leading to scores of –2.

As noted in Section 2.8.2, no scores were based on toxicants in the elutriate because there was no evidence of problems since 1986. Therefore, only the reduction in turbidity, associated with OBC, UpC, and UpTL and the loss of water volume for plankton and nekton, associated with the creation of OBC and OBSC placement areas, led to Water Quality scoring. There is some turbidity associated with OBUn, so the reduction of turbidity for UpC and UpTL led to partial scores of +1. OBC, which reduced turbidity but caused a volume loss for aquatic flora and fauna, received a score of 0, while OBSC, which caused the volume loss but did not reduce turbidity completely, received a score of –0.5. OcnP, which only transferred the turbidity from the Laguna to the Gulf of Mexico but caused no volume loss, received a score of 0.

Scores for Human Uses were determined by the number of acres removed from existing uses by placement. The existing placement areas have been designated for OBUn, so OBUn removes 0 acres from existing practice. OBC and OBSC remove 62 and 70 acres of the Laguna Madre, respectively, from existing uses of fishing, boating, etc., leading to scores of –1 for being in the 1-to-100-

acre category. UpC and UpTL removed 176 and 172 acres, respectively, and received scores of –2. OcnP removed 0 acres from existing uses and received a score of 0.

2.10.5.4 Post-Placement Action

The Post-Placement action is a little more complicated because, as can be seen from Table 2-31, there are more types of impacts per receptor than for the other actions. For example, there is burial of 139 acres of seagrass by OBUn, but there is empirical evidence (Sheridan, 1999) that recovery occurs over 75 percent of this area between dredging cycles, so 25 percent of this is considered a long-term loss. OBC and OBSC, on the other hand, lead to permanent losses of seagrass of 50 and 56 acres, respectively, leading to partial scores of –1. However, the computer models showed 10 acres between the isopleths for 20 percent irradiance reaching the seagrasses, with and without OBUn. It was assumed that there would be no acreage differences between isopleths for the other options, so OBC and OBSC received partial scores of +1, based on the acreage between the isopleths. The average of partial scores of –1 and +1 is 0. Therefore, OBC and OBSC received final scores of 0.

The acres of seagrass lost to the booster pump channels for OcnP is greater than the long-term acreage for OBUn, while the acres of seagrass lost to the booster pump channels for UpC and UpTL is less than the long-term acreage for OBUn, and are also long-term loss and probably permanent. Therefore, there is a loss in the 1-to-100-acre scoring range, leading to a partial score of –1 when OcnP is compared with OBUn but partial scores of +1 for UpC and UpTL. Averaged with the +1, based on the acreage between the isopleths, leads to a final score of 0 for OcnP and +1 for UpC and UpTL.

Research has shown that benthos recover rapidly, except in the immediate vicinity of the placement area (Sheridan, 1999). Therefore, the area of impact for post-placement for OBUn is not enough to change the permanent or long-term impacts of the other options and, all options except OcnP, which impacts no Open-Bay Bottom, received scores of –1. OBSC will allow temporary creation of Emergent Bay Habitat from Seagrass and Open-Bay Bottom and received a partial score of +1. UpC and UpTL each cause a long-term loss of 30 acres of Emergent Bay Habitat, while OcnP caused a long-term loss of 72 acres. Since these are all in the 1-to-100-acre range, these three options received a partial score of –1. OBC affected 0 acres of Emergent Bay Habitat, leading to a partial score of 0. No piping plover sites are impacted by any option, leading to partial scores on 0. Averages of the partial scores for each option are presented in Table 2-31.

OBC and OBSC will allow temporary creation of Terrestrial Habitat for scores of +1. UpC will permanently remove 176 acres of Terrestrial Habitat from customary usage for a –2, whereas, UpTL should improve 172 acres (see Section 2.9.3.2) for a +2. OcnP would cause the loss of 15 acres of Terrestrial Habitat for a score of –1.

All Water Column scores are 0 since, while there is turbidity associated with OBUn, the seagrass model showed no long-term difference between the with- and without-placement scenarios, and the sediment transport model showed a sharp decrease in the difference between the with- and without-placement turbidity within a few months. Therefore, the fact that some other options reduce that turbidity is not a quantifiable benefit.

For impacts to Human Uses, all of the options produce minimal to no TSS, according to the models, and there are no impacts to coastal cabins, so the only scoring comes from the long-term aesthetic impact of 176 acres of Upland Confined placement areas to a height of 33'. Therefore, for UpC, a partial score of 0, for no TSS averaged with a partial score of 0 for the loss of no coastal cabins, and –1 for LTA impacts, leads to a final score of –0.3. OBC, OBSC, UpTL, and OcnP generate no TSS, impact no coastal cabins, and have no LTA impacts, leading to final scores of 0.0.

2.10.6 Reach 6

The discussion in this section is based on the scoring criteria presented above in Section 2.8.2. The results of the Matrix are summarized in Table 2-32.

2.10.6.1 Dredging Action

The Dredging Action column is based on the acres of the receptors, except for Water Column Effects and Human Uses. Since all dredging occurs in the GIWW, no acres of any receptor are impacted and therefore, the score for all options is 0. For Water Column Impacts, the turbidity and toxicity effects, if there are any, would be the same for all options during the dredging phase, and all scores are 0. Human Use impacts are based on the number of dredging/construction days, which is 588 for the present practice, OBUn. For OBC (971 days or 383 > OBUn) and OBSC (882 days or 294 > OBUn), the number of days is within the range of 101 to 500 greater than OBUn, leading to scores of –1. For UpC and UpTL (both 1,416 days or 828 > OBUn), the number of days is within the range of 501 to 1,000 greater than OBUn, leading to scores of –2. OcnP (2,353 days) requires 1,765 days more than OBUn, leading to a score of –3.

2.10.6.2 Conveyance Action

The Conveyance Action column is also based on the acres of the receptors, except for Water Column Effects and Human Uses. For all of the acre receptors, there are impacts from laying pipelines and dredging booster channels, which fall into the 1 – 100 range (with one exception), leading to score of –1 for UpC, UpTL, and OcnP, for one or more receptors. The exception is that OcnP impacts 124 more acres of seagrass than does OBUn, leading to a score of –2. There are no water column effects from the other options, relative to the present practice, OBUn, except for those associated with the booster channel dredging for UpC, UpTL, and OcnP, which leads to a score of –1 for these three options. For Human Uses, all options have more pmds than OBUn in the range of 2,501 – 10,000, for OBC, OBSC, UpC and UpTL, generating scores of –2, and >10,000 for OcnP, leading to a score of –3.

2.10.6.3 Placement Action

The Placement Action column is also based on the acres of the receptors, except for Water Column Effects and Human Uses. The guidance given in Section 2.8.2 and the fact that all options

Table 2-32

Matrix Summary for Reach 6

Receptor	Option	Dredging Impact	Dredging Score	Conveyance Impact	Conveyance Score	Placement Impact	Placement Score	Post-placement Impact	Post-placement Score	Total
Seagrass	OBUn	0 ac	0.0	0 ac	0.0	596 ac	0.0	149 Long term ac 176 20% isopleth ac	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	420 ac	2.0	420 Permanent ac 0 20% isopleth ac	0.0	**2.0**
	OBSC	0 ac	0.0	0 ac	0.0	456 ac	2.0	456 Permanent ac 0 20% isopleth ac	0.0	**2.0**
	UpC	0 ac	0.0	38 ac	-1.0	0 ac	2.0	38 Long term ac 0 20% isopleth ac	2.0	**3.0**
	UpTL	0 ac	0.0	38 ac	-1.0	0 ac	2.0	38 Long term ac 0 20% isopleth ac	2.0	**3.0**
	OcnP	0 ac	0.0	124 ac	-2.0	0 ac	2.0	124 Long term ac 0 20% isopleth ac	1.5	**1.5**
Open-Bay Bottom	OBUn	0 ac	0.0	0 ac	0.0	895 ac	0.0	0 * ac	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	630 ac	2.0	630 Permanent ac	-2.0	**0.0**
	OBSC	0 ac	0.0	0 ac	0.0	685 ac	2.0	685 Permanent ac	-2.0	**0.0**
	UpC	0 ac	0.0	42 ac	-1.0	0 ac	2.0	42 Long term ac	-1.0	**0.0**
	UpTL	0 ac	0.0	42 ac	-1.0	0 ac	2.0	42 Long term ac	-1.0	**0.0**
	OcnP	0 ac	0.0	10 ac	-1.0	0 ac	2.0	10 Long term ac	-1.0	**0.0**
* Benthos recover rapidly except very near PA										
Emergent Bay Habitat	OBUn	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 ac, 0 PP**	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 ac, 0 PP	0.0	**0.0**
	OBSC	0 ac	0.0	0 ac	0.0	0 ac	0.0	Temp creation, 0 PP	0.5	**0.5**
	UpC	0 ac	0.0	4 ac	-1.0	0 ac	0.0	4 Long term ac, 0 PP	-0.5	**-1.5**
	UpTL	0 ac	0.0	4 ac	-1.0	0 ac	0.0	4 Long term ac, 0 PP	-0.5	**-1.5**
	OcnP	0 ac	0.0	7 ac	-1.0	0 ac	0.0	7 ac, 0 PP	-0.5	**-1.5**
** Piping Plover Sites										
Terrestrial Habitat	OBUn	0 ac	0.0	0 ac	0.0	0 ac	0.0	0 ac	0.0	**0.0**
	OBC	0 ac	0.0	0 ac	0.0	0 ac	0.0	Temp creation	1.0	**1.0**
	OBSC	0 ac	0.0	0 ac	0.0	0 ac	0.0	Temp creation	1.0	**1.0**
	UpC	0 ac	0.0	28 ac	-1.0	716 ac	-2.0	716 Permanent ac	-2.0	**-5.0**
	UpTL	0 ac	0.0	28 ac	-1.0	745 ac	-2.0	745 Improvement ac	2.0	**-1.0**
	OcnP	0 ac	0.0	24 ac	-1.0	0 ac	0.0	24 Long term ac	-1.0	**-2.0**
Water Column Effect	OBUn	0 ac	0.0	booster chann	0.0	ty, no volur	0.0	No long-term turbidity	0.0	**0.0**
	OBC	0 ac	0.0	booster chann	0.0	No	0.0	Reduce turbidity	0.0	**0.0**
	OBSC	0 ac	0.0	booster chann	0.0	Turbidity,	-0.5	No long-term turbidity	0.0	**-0.5**
	UpC	0 ac	0.0	ooster channe	-1.0	No	0.5	Reduce turbidity	0.0	**-0.5**
	UpTL	0 ac	0.0	ooster channe	-1.0	No	0.5	Reduce turbidity	0.0	**-0.5**
	OcnP	0 ac	0.0	ooster channe	-1.0	Transfer turbidity,	0.0	Reduce turbidity	0.0	**-1.0**
Human Uses	OBUn	588 days	0.0	588 pmd[a]	0.0	0 ac	0.0	Minimal TSS, 0 CC[b], no LTA[c]	0.0	**0.0**
	OBC	971 days	-1.0	6,794 pmd	-2.0	1,050 ac	-3.0	No TSS, 0 CC, no LTA	0.0	**-6.0**
	OBSC	882 days	-1.0	6,176 pmd	-2.0	1,141 ac	-3.0	Minimal TSS, 0 CC, no LTA	0.0	**-6.0**
	UpC	1,416 days	-2.0	9,915 pmd	-2.0	716 ac	-2.0	No TSS, 0 CC, LTA	-0.3	**-6.3**
	UpTL	1,416 days	-2.0	9,915 pmd	-2.0	745 ac	-2.0	No TSS, 0 CC, no LTA	0.0	**-6.0**
	OcnP	2,353 days	-3.0	68,235 pmd	-3.0	0 ac	0.0	No TSS, 0 CC, no LTA	0.0	**-6.0**

[a] pipeline-mile-days; [b] Coastal Cabins; [c] Long-term aesthetic effect

impact the same or fewer acres than does OBUn, lead to neutral or positive scores for Seagrass, Open-Bay Bottom, and Emergent Bay Habitats. UpC and UpTL impact 716 and 745 more acres of Terrestrial Habitat, respectively, than does OBUn, leading to scores of –2.

As noted in Section 2.8.2, no scores were based on toxicants in the elutriate because there was no evidence of problems since 1986. Therefore, only the reduction in turbidity, associated with OBC, UpC, and UpTL and the loss of water volume for plankton and nekton, associated with the creation of OBC and OBSC placement areas, led to Water Quality scoring. There is some turbidity associated with OBUn, so the reduction of turbidity for UpC and UpTL led to partial scores of +1, while these options lead to no volume loss, for a partial score of 0, and an average score of +0.5. OBC, which reduced turbidity (partial score of +1) but caused a volume loss for aquatic flora and fauna (partial score of –1), received an average score of 0, while OBSC, which caused the volume loss but did not reduce turbidity completely, received an average score of –0.5. OcnP, which only transferred the turbidity from the Laguna to the Gulf of Mexico but caused no volume loss, received an average score of 0.

Scores for Human Uses were determined by the number of acres removed from existing uses by placement. The existing placement areas have been designated for OBUn, so OBUn removes 0 acres from existing practice. OBC and OBSC remove 1,050 and 1,141 acres of the Laguna Madre, respectively, from existing uses of fishing, boating, etc., leading to scores of –3 for being in the >1,000 acre category. UpC and UpTL removed 716 and 745 acres of Terrestrial Habitat from customary use, respectively, which put them in the 100 – 1,000 acre category, and both received a score of –2. OcnP removed 0 acres from existing uses and received a score of 0.

2.10.6.4 Post-Placement Action

The Post-Placement Action is a little more complicated because, as can be seen from Table 2-32, there are more types of impacts per receptor than for the other actions. For example, there is burial of 596 acres of seagrass by OBUn, but there is empirical evidence (Sheridan, 1999) that recovery occurs over 75 percent of this area between dredging cycles, so 25 percent of this is considered a long-term loss. OBC and OBSC, on the other hand, lead to permanent loss of seagrasses of 420 and 456 acres of seagrass, respectively, leading to partial scores of –2. However, the computer models showed 176 acres between the isopleths for 20 percent irradiance reaching the seagrasses, with and without OBUn. It was assumed that there would be no acreage differences between isopleths for the other options, so OBC and OBSC received partial scores of +2, based on the acreage between the isopleths. The average of partial scores of –2 and +2 is 0. Therefore, OBC and OBSC received final scores of 0.

The acres of seagrass lost to the booster pump channels for UpC and UpTL is less than the long-term acreage for OBUn, and is also long-term loss and probably permanent. Therefore, there is a gain in the 101 – 1,000 acre scoring range, leading to partial scores of +2 when UpC and UpTL are compared with OBUn. Averaged with the +2, based on the acreage between the isopleths, leads to final scores of +2, for these two options. The acres of seagrass lost to the booster pump channels for OcnP is less than the long-term acreage for OBUn, leading to a gain in the 1-to-100-acre scoring range, for a partial score of +1, when OcnP is compared with OBUn. Averaged with the +2, based on the acreage between the isopleths, leads to a final score of +1.5 for the OcnP option.

Research has shown that benthos recover rapidly, except in the immediate vicinity of the placement area (Sheridan, 1999). Therefore, the area of impact for post-placement for OBUn is not enough to change the permanent or long-term impacts of the other options and, therefore, OBC and OBSC received scores of –2, while UpC, UpTL, and OcnP received scores of –1.

OBSC will allow temporary creation of Emergent Bay Habitat from Seagrass and Open-Bay Bottom and received a partial score of +1. UpC and UpTL each cause a long-term loss of 4 acres of Emergent Bay Habitat, while OcnP caused a long-term loss of 7 acres. Since these are all in the 1-to-100-acre range, these three options received a partial score of –1. OBC affected 0 acres of Emergent Bay Habitat, leading to a partial score of 0. No piping plover sites are impacted by any option, leading to partial scores on 0. Averages of the partial scores for each option are presented in Table 2-32.

OBC and OBSC will allow temporary creation of Terrestrial Habitat for scores of +1. UpC will permanently remove 716 acres of Terrestrial Habitat from customary usage for a –2, whereas UpTL should improve 745 acres (see Section 2.9.3.2) for a +2. OcnP would cause the loss of 24 acres of Terrestrial Habitat for a score of –1.

All Water Column scores are 0 since, while there is turbidity associated with OBUn, the seagrass model showed no long-term difference between the with- and without-placement scenarios, and the sediment transport model showed a sharp decrease in the difference between the with- and without-placement turbidity within a few months. Therefore, the fact that some other options reduce that turbidity is not a quantifiable benefit.

For impacts to Human Uses, all of the options produce minimal to no TSS, according to the models, and there are no impacts to coastal cabins, so the only scoring comes from the long-term aesthetic impact of 716 acres of Upland Confined placement areas to a height of 31 feet. Therefore, for UpC, a partial score of 0, for no TSS, averaged with a partial score of 0, for the loss of no coastal cabins, and –1 for LTA impacts, leads to a final score of –0.3. OBC, OBSC, UpTL, and OcnP generate no TSS, impact no coastal cabins, and have no LTA impacts, leading to final scores of 0.0.

2.10.7 Discussion and Summary

NEPA requires that impacts to the human environment be addressed by an EA or an EIS. Human Environment "shall be interpreted comprehensively to include the natural and physical environment and the relationship of people to that environment" (40 CFR 1508.14). The method used here to arrive at the preferred placement alternative, by reach, was developed with the help of the ICT to allow for a systematic, objective approach to selection. It is an approach that balanced the impacts to the various components of the human environment and could be applied without knowledge of the ultimate outcome of the analysis.

An examination of Tables 2-27 through 2-32 indicates that if the scores were summed by alternative, the present practices, Open-Bay Unconfined Placement in Reaches 1, 2, 4, 5, and 6 and Upland Confined Placement in Reach 3, are the preferred alternatives. For Reach 3, the selection is intuitively obvious; i.e., upland placement areas exist and have been used for years, ocean placement is not feasible, and open-bay options would require covering seagrasses and algal/sand flats in The Hole, the closest open-bay habitat. Additionally, Impacts to Human Uses in Reach 3, clearly favor Upland Placement due to the large number of days for dredging and construction, with concomitant interference with fishing and boating; the large increase in pmd, with concomitant interference with human uses and increased risk to human safety; and the long-term losses to The Hole.

For Reaches 1, 2, and 4, Open-Bay Unconfined appears the preferred alternative, driven largely by impacts to Human Uses. The interference with human uses of the Laguna Madre, plus the safety issues associated with the large increase in dredging/construction days and pmd, and the removal of large acreages from existing uses, combine to increase impacts from the placement alternatives compared with present practice. Additionally, the loss of coastal cabins in these reaches, especially the loss of 33 cabins in Reach 2, and the loss of known piping plover usage sites in Reach 2, added to the negative scores for some options.

For Reach 5, Open-Bay Confined and Open-Bay Semiconfined both had scores of –1.0, so Open-Bay Unconfined was not as preferable as with Reaches 1, 2, and 4. This was in part due to fewer impacts to seagrasses and Human Uses than in Reaches 1–4. The favorable scores for these items were due to the fact that the amount of maintenance material from Reach 5 is relatively small and, therefore, placement areas are small.

For Reach 6, there are significant impacts to Human Uses because of increases in dredging/construction days and pmd associated with larger placement areas and longer pipelines for ocean placement to avoid the City of South Padre Island. Benefits to seagrass for all options in Reach 6 were more dramatic than for Reach 5, primarily due to the number of acres between the 20 percent light irradiance isopleths, with and without Open-Bay Unconfined placement. However, the benefits to seagrass did not completely offset the increased impacts to Human Uses, and Open-Bay Confined and Open-Bay Semiconfined placement both received scores of –3.

Originally, the scores for the various receptors were to be summed by alternatives to yield an overall composite score by alternative. As can be seen, from an examination of Table 2-27, for example, this would lead to composite scores for Reach 1 from 0.0 for the present practice (OBUn) to –12.3 (UpC). However, Human Uses dominated most reaches and the ICT recommended, after much discussion, that there is too much "apples to oranges" comparison in this approach and that, without weighting factors, a summing approach could not be used. However, before coming to an agreement on weighting factors, the ICT determined that it would be necessary to include a management plan for each PA separately in the DMMP. Therefore, the ICT decided to build on the information developed during the matrix analysis and examine the data developed in smaller units. For some areas, several PAs could be grouped together, whereas in other areas, the analysis would have to focus down to individual PAs. Even where several PAs could be grouped, the ICT recommended that the final DMMP be developed so that each PA and its management plan were described individually. This was deemed advantageous since past dredging contracts were let that covered different, sometimes widely separated, portions of the Laguna Madre, and the PAs that were grouped for analysis might not all be dredged at the same time.

2.11 DREDGED MATERIAL MANAGEMENT PLAN

As noted above, the ICT believed that the best DMMP would be one that examined each PA, individually. Therefore, in a series of meetings, a DMMP was developed which is included in full in Appendix A, and is summarized here. For each PA in each reach, available information on frequency of use, quantity of dredged material placed on the PA per dredging cycle, size of the PA, and grain size was generated from historical USACE records from May 1949 through March 1995 (Table 2-33). Information on seagrass coverage was obtained from current information and the locations of PAs were more accurately determined and superimposed on the 1995–1996 Digital Orthographic Quarter-Quads (DOQQs) and made available to the ICT, via printed copies and computer-aided projection on a screen, so that the ICT members could examine each particular area, as needed. Also included in Table 2-33 is information on the expected useful life of fully confined PAs included in the DMMP.

The ICT considered several alternative methods for dredging and placement of shoaled material in the GIWW to identify the least environmentally damaging alternative that was within the engineering capabilities of the USACE and was economically feasible. The ICT reached consensus on the DMMP, which is depicted in Figure 1-2a through f.

The PAs will be managed primarily for reducing impacts to nearby seagrass habitat, but some sites will be managed for bird use, vegetation control, or public recreation use. All discussions on management of the PAs in Reach 1 and some of the PAs in Reach 2 include the recommendations of Dr. Allan Chaney and Mr. Gene Blacklock based on the latest bird use information and management strategies (will be included as Appendix B when available) needed to enhance the sites for birds. Special concerns on management practices, as contained in the PINS management plan (Draft included as Appendix C), of the PAs located inside the Congressionally authorized boundaries of PINS have been addressed as well. The Permanent School Fund's minerals in the project area can and will be developed, and the dredging and disposal of dredged materials from the GIWW in the Laguna Madre will not put an added burden on minerals development.

In some cases, the ICT recommended it would best facilitate dredged material management in a PA if the designated boundaries were shifted to include all of an island or nearby deep, unvegetated water. All islands inside the PAs were created during GIWW construction and nourished with shoaled material during subsequent maintenance dredging operations. The ICT also recommended that new PAs were needed or existing PAs should be combined to meet special management requirements or to handle excess dredged material if it is determined an existing PA cannot accommodate all the material normally designated for the site and meet the goals of the management plan. If any of the new PAs are located outside of the existing disposal easements, the USACE will use the submerged sites pursuant to the Navigation Servitude Authority. However, PAs 178 through 235 in the preferred alternative (DMMP) all fall within navigable waters of the United States or are on top of islands created by direct deposit of

TABLE 2-33

HISTORICAL MAINTENANCE MATERIAL INFORMATION

Reach	Segment	PA	Average % Sand	# Uses (1948-1995)	Frequency of Use (1948-1995) (yrs)	Size of Designated PA (ac)	Per Cycle Discharge (CY)	Annual Discharge (CY)	Approximate Useful Life* (Years)
1	1	175	N/D	0	N/A	29.1	N/A	N/A	
		176	50.10	1	46.4	133.8	128,041	2,760	813
		177	72.20	1	46.4	35.8	74,691	1,610	
		178	N/D	2	23.2	125.3	100,408	4,328	
		179	68.20	2	23.2	40.1	30,940	1,334	
		180	N/D	5	9.28	125.6	122,564	13,207	
		181	36.28	6	7.73	96.6	73,253	9,472	
	2	182	4.22	3	15.5	58.5	61,126	3,952	
		183	79.90	3	15.5	152.1	115,008	7,436	
		184	7.35	4	11.6	98.7	84,640	7,297	
		185	58.20	6	7.73	105.4	104,431	13,504	
		186	33.73	10	4.64	117.4	126,495	27,262	
	3	187	24.02	13	3.57	137.8	183,893	51,522	
		188	27.14	14	3.31	165.8	196,804	59,380	
		189	N/D	14	3.31	124.7	157,432	47,501	
		190	20.85	11	4.22	69.9	114,168	27,066	
		191	4.90	8	5.80	57.3	95,129	16,402	
2	4	192	33.40	9	5.16	90.6	80,009	15,519	
		193	N/D	9	5.16	90.6	87,218	16,917	
		194	55.21	12	3.87	121.5	92,550	23,935	
		195	85.00	10	4.64	103.0	112,778	24,306	
		196	50.56	7	6.63	103.0	102,946	15,531	97
	5	197	25.40	15	3.09	304.4	318,930	103,102	
		198	34.40	18	2.58	146.2	132,755	51,500	
		199	11.87	16	2.90	124.9	140,854	48,570	
		200	27.00	15	3.09	196.2	156,537	50,605	
		201	18.32	14	3.31	173.7	177,145	53,449	
		202	7.58	16	2.90	195.6	195,382	67,373	83
3	6	203	27.08	6	7.73	324.5	149,376	19,316	137
		204	71.50	5	9.28	167.7	100,581	10,838	389
	7	206	N/D	5	9.28	380.4	352,592	37,995	120
		207	N/D	5	9.28	322.2	524,366	56,505	123/257**
	8	208	75.30	9	5.16	769.0	715,043	138,694	86/67**
	9	209	N/D	6	7.73	193.4	110,338	14,268	
		210	N/D	13	3.57	242.8	81,911	22,949	
4	10	211	30.44	15	3.09	140.8	117,247	37,903	
		212	28.17	15	3.09	192.1	175,985	56,892	
		213	16.06	14	3.31	191.7	101,885	30,741	
	11	214	17.54	9	5.16	191.4	216,337	41,962	
		215	7.41	11	4.22	194.1	193,123	45,783	
		216	12.17	6	7.73	194.7	149,645	19,351	
		217	22.90	8	5.80	193.3	181,505	31,294	
	12	218	18.75	12	3.87	194.3	218,230	56,439	
		219	13.14	10	4.64	119.8	112,608	24,269	
		220	8.05	10	4.64	216.1	153,758	33,138	
	13	221	8.35	17	2.73 **	387.2	177,214	64,928	
		222	23.18	10	4.64	259.4	183,776	39,607	132
5	14	223	56.00	6	7.73	158.8	92,078	11,907	254
		224	35.17	3	15.5	175.4	58,422	3,777	909
		225	14.70	1	46.4	84.3	83,936	1,809	1,362
		226	N/D	13	3.57	257.6	84,497	23,674	400
	15	227	22.99	5	9.28	65.4	91,128	9,820	
		228	16.48	5	9.28	294.4	122,115	13,159	600/479**
6	16	229	6.71	3	15.5	129.2	27,740	1,794	
		230	N/D	1	46.4	82.5	43,260	932	
		231	N/D	1	46.4	127.8	69,982	1,508	
		232	16.89	12	3.87	127.4	57,126	14,744	
	17	233	8.01	24	1.93	210.0	392,773	203,158	
		234	12.62	25	1.86	121.6	227,513	122,582	
		235	30.46	5	9.28	121.6	43,053	4,639	

TABLE 2-33

HISTORICAL MAINTENANCE MATERIAL INFORMATION

Reach	Segment	PA	Average % Sand	# Uses (1948-1995)	Frequency of Use (1948-1995) (yrs)	Size of Designated PA (ac)	Per Cycle Discharge (CY)	Annual Discharge (CY)	Approximate Useful Life* (Years)
		236	N/D	N/D	N/D	129.1	N/D	N/D	
	18	239	53.99	6	7.73	49.4	86,056	11,128	
		240	39.30	5	9.28	N/D	97,482	10,505	

* This is the expected useful life for these confined PAs, based on caluclations made with models developed by the USACE Waterways Experiment Station, known grain size characteristics, and an ultimate levee height of 20' for PAs 176 - 208 and 25' for PAs 222 - 228S. This calculation is only applicable to fully-confined sites are other sites are not included in this column.

** These PAs contain two separate confined areas, north and south. The expected usefule life of the north area is listed first.

*** Historic use of Pa 221 has varied from higher use (the frequency presented above) in the northern one-fourth to less frequent use (6 - 7 years) in the southern three-fourths.

dredged material, which thereby remain subject to the navigation servitude under the Commerce Clause of the United States Constitution (there are no changes to PAs 236, 239, or 240). This power grants the United States the prior right to use the bed and banks of navigable waters for the purposes of navigation without payment of just compensation to the owner, even if the owner is still the State of Texas or a subsequent patentee. Along the entire alignment of the GIWW between Corpus Christi and the Mexican border, the United States, on August 21, 1947, was granted a perpetual 900-foot-wide channel right-of-way easement to state-owned land to cut the initial channel as well as a perpetual easement for the placement of dredged material along a strip, 5,000 feet wide along the east side of the right of way strip just described. While the vast majority of the easement was unnecessary due to the powers of the United States under the navigation servitude, the easement would come into play on fast lands (naturally occurring) not subject to the servitude. Therefore, all existing areas and all proposed expansions of placement areas on the east side of the existing GIWW are covered both by the navigation servitude and/or the 1947 perpetual dredged material disposal easement. All new or expanded placement areas on the west side of the existing GIWW are covered by the navigation servitude. Therefore no acquisition of real estate interests is required for any of the placement areas proposed along the GIWW in the Laguna Madre

Another concern of the ICT is the issue of coastal cabins located inside the PAs in the upper Laguna Madre. Many of these cabins, which have GLO permits, could be damaged if the entire PA is used for disposal. At their discretion, GLO/State Land Board will require cabins to be relocated or removed, as necessary, prior to placement of dredged material.

The management plans in the DMMP will be reviewed prior to each dredging event to ensure the best management practice for each PA in every reach is incorporated to the extent practicable. It is assumed that all pumping of dredged material will be done by the best management practices, including the use of a dispersing or energy-dissipating device to reduce the erosive force of water exiting the pipe and frequent movement of the pipe so that the material is spread out in a thin layer to decrease the chances of excessive burial of seagrass and creating a scour hole at discharge.

To minimize impacts to seagrass, the ICT recommended that the management plan observe the restriction of confining open-bay, unconfined placement of maintenance material to the period from November to February, inclusive, throughout the Laguna Madre. Dunton et al. (2002) have noted that this is the period when seagrass is dormant and will be impacted least by turbidity. Hydrodynamic and Sediment Transport modeling also indicated that the worst-case scenario of the impact from high turbidity levels (reducing light penetration to the seagrass below 20 percent of surface irradiance) is usually confined to an area within ¾ to 1 mile of the open-water discharge point and such high turbidity conditions attributable to unconfined disposal generally occur over a period of less than 3 months after disposal is completed. Another impact of dredged material disposal is seagrass burial when the mud flows away from the point of discharge. Additional studies have shown that if seagrass is buried under no more than 3 inches of sediment, it can fully recover in about 3–5 years. However, in the case of shoalgrass, the dominant seagrass in most of the Laguna Madre, studies also have shown that new shoalgrass quickly invades the buried site through seed dispersal to create new seagrass meadows before the original plants have a chance to regenerate. Therefore, if dredging and disposal operations are conducted during the dormant phase of seagrass growth, the plants are not affected as much as in other seasons, unless they are buried. Even with burial close to the PA, shoalgrass can quickly recover through colonization by new plants or growth of the original plants if burial is less than 3 inches.

2.11.1 Reach 1

This Reach contains PAs 175 through 191. PAs 182, 183, 185, 187, 188, 190, and 191 are inside the Congressionally authorized PINS boundary.

The ICT considered all of the alternative dredging and placement options described earlier in this section of the DEIS for these PAs. Following the criteria designed to identify fatal flaws in a disposal option, the ICT recommended eliminating ocean placement as a viable option due to the long haul distances, lack of appropriate equipment, and excessive pumping distances for pipeline disposal. One other option, piping the material across Padre Island was eliminated in most of Reach 1 because the PINS could not permit it, since this action would represent an impairment of natural resources in the Park. Likewise, Upland Confined and Upland Thin Layer Placement were eliminated from further consideration because of the permanent impacts to seagrass and wetland habitats that could occur in installing the pipelines for pumping the material to an upland site. The required pumping distances also could require booster pumps, which would reduce efficiency. The only remaining options (fully confined, semiconfined, and unconfined open-bay placement) were analyzed for each PA in Reach 1 before determining the best option, given the unique combination of habitat, dredging frequency and volume, and environmental management plans proposed for each PA.

In addition to managing the PAs for seagrass, bird use, and recreational opportunities proposed by others (when compatible with the DMMP), the ICT reviewed the management plan prepared by the PINS for PAs located inside the Congressionally authorized PINS boundaries for compatibility with the DMMP. The disposal practices described in the PINS plans were incorporated into the DMMP to the extent practicable. Some of the limitations on disposal described in the PINS plan could not be incorporated due to the type of material and dredging frequency or volume, but the ICT recommended each PA management plan be reviewed prior to dredging and placement to determine the best plan for that dredging cycle in coordination with the PINS personnel.

In the past, placement of maintenance material in this reach was strictly open-bay placement. A number of techniques were proposed in the DMMP to reduce turbidity, reduce coverage of seagrass, and encourage bird use. Under the DMMP, only one PA includes no changes from present practice and it has never been used since dredging of the GIWW through the Laguna Madre. One PA will be fully leveed and four others are scheduled for partial levees or training levees to control flow of the dredged material. Material will be placed on the emergent islands, using diffusers, on fourteen of the PAs; care will be taken to avoid circulation channels at five; and material will be pumped to deeper water to avoid seagrass at one other PA. Five PAs are scheduled to take on a limited amount of material, with the excess pumped to nearby PAs; four are scheduled to be expanded for bird use or seagrass avoidance; and the impacts from two new PAs are included in Section 4. The following is a summary of the actions proposed in the DMMP by PA.

PA 175 – Continue with the current practice of not using this upland, unconfined PA, but it will remain as an authorized PA.

PA 176 – Complete the levee and use the site as an upland confined placement option. The USFWS will be consulted before levee construction begins to ensure there are no adverse impacts to the piping plover.

PA 177 – Make complete levees on the east (back), north, and south sides, with a partial levee and baffles on the west side to retain as much material on the island as possible. This would partially contain the dredged material and prevent the material from flowing north, east, or south onto seagrass beds.

PA 178 – Protect the seagrasses to the east with a training levee. The circulation channels will be left open. The northern islands in the chain would be avoided unless needed in the future, but the PA would be expanded to the south to include the island immediately to the south. The second island from the north is an important bird nesting island and will be avoided during disposal operations. Flow onto the emergent islands would be directed to the west, using natural contours as much as possible. The cabin owner may need to be notified that the cabin will be impacted by future disposal.

PA 179 – Expand the PA to include all of the islands and pump the maintenance material on top of the mounds to increase the size of these islands for bird use, while avoiding runoff onto the seagrasses to the extent possible. A training levee will be placed on the south end of the PA to prevent maintenance material from filling a small boat channel. Six of the nine cabins inside the present and proposed boundaries may be affected.

PA 180 – Pump the maintenance material to the east side of the mounds with a diffuser at the end of the pipe to prevent scouring and direct the flow to the east to increase the size of these islands for bird use. This technique will help reduce runoff onto the seagrasses. Care will be taken to keep circulation channels open. Eleven cabins may be affected.

PA 180A – Incorporate the bird plan to nourish and rebuild two man-made islands on the west side of the GIWW opposite from PA 180 to establish a new PA (PA 180A) at this location and use some of the maintenance material to rebuild the islands on an "as needed" basis. Because there will be new impacts to seagrass beds around the area, the USACE agreed to this plan only if the rest of the ICT concurs and there is no mitigation required for loss of seagrass. There is one cabin on one of these islands.

PA 181 – Pump the maintenance material on top or just east of the mounds to direct the flow to the east side to increase the size of these islands for bird use. This technique will help reduce runoff onto the seagrasses. Care will be taken to keep circulation channels open. Eight permitted cabins and one cabin used by TAMU for research may be affected.

PA 182 – Avoid the Fina Mitigation Area located east of the northern part of the PA and the trees on the northern one-third of the site. Trees and shrubs in the working area would be protected from moving equipment and dredge pipe. Placement of dredge material either on top or east of the island would protect or avoid trees and shrubs. The maintenance material would be pumped on top or to the east side of the mounds at the southern two-thirds of the PA to direct the flow to the east side to increase the size of these islands for bird use. A diffuser will be used on the end of the dredge pipe to minimize energy and prevent scouring on the mounds. This should help maximize disposal on the island and minimize runoff into the surrounding water and seagrasses. Extend the southern PA boundary to include all of the island.

PA 182S – As part of the PINS management plan, the PINS proposed adding a new disposal site to the DMMP. The new site would enclose a small island located between PAs 182 and 183 that was probably created during construction of the GIWW. There is a pond on the island that PINS would like to protect during disposal operations. The ICT recommended that the new site be added to the DMMP. The new PA will be used for disposal during a dredging cycle for this reach of the GIWW when the need is determined by PINS and the ICT.

PA 183 – Pump some of the maintenance material over the top and to the east side of the mounds at the south end of the PA to manipulate vegetative cover and enlarge the islands to the east for bird use. It may also be desirable to pump some material to the east side of the other islands, but the timing and need for this will be determined during coordination with the ICT and PINS. Material that cannot be utilized in PA183 will be pumped to PA184. The amount of material to be used at this site will be determined during preparation of disposal plans for each dredging cycle and in coordination with the ICT and PINS.

PA 184 – Pump the maintenance material over the crest to the west side of the islands to avoid coastal cabins, if possible, and avoid runoff onto seagrasses adjacent to the islands. However, avoidance of the coastal cabins may not be possible. Sixteen cabins inside the PA and 9 cabins outside the PA may be affected by this management plan. Emmord's Hole, located west of the PA, will be used only if the ICT concludes there is a compelling need for it. A complete discussion of Emmord's Hole is included as Section 2.11.7.

PA 185 – Place some (if not all) of the maintenance material on the east side of the lower two islands to build up the beach. Care must be taken to avoid filling in the wide channel between the northern island and South Bird Island northeast of the PA, as well as the small boat channel connecting Bird Island Basin to the GIWW. Material that cannot be utilized in PA185 will be pumped to PAs 184, 186, or Emmord's Hole. Extend the southern boundary of the PA to include all of the southernmost island to increase the size of the disposal area.

PA 186 – Extend the PA boundary to the west to include deep water in Emmord's Hole and pump the maintenance material to the deeper water west of the PA to avoid seagrass. This also would avoid the cabins on the island in the northern portion of the PA.

PA 187 – Pump some of the maintenance material on top of the emergent mounds on the south side of the north island and the north side of the south island to increase their size and enhance them for bird nesting. Dredged material will not be placed on the ridge along the middle of the PA to avoid the seagrasses and prevent the islands from coalescing. The ICT recommended that excess material be put in Emmord's Hole only if there is no other option available.

PA 188 – Pump maintenance material on top of the emergent mounds on the island in the north portion of the ridge to increase the size of the island for bird use. Emmord's Hole would be used as an alternate site for excess material from this PA only if there is no other option available.

PA 189 – Follow the bird management plan and try to reestablish the southern island with dredged material for bird use. Because the material may not stack, the USACE will look into using a retaining system (sheetpile, geotubes, levees, etc.) to help retain material at the site. Extend the western boundary of PA 189 about 1,000 feet west at the north end and taper this new boundary back to the southwest corner of the PA, forming a triangular extension into deeper water to the west. The new area will allow the USACE to place the dredge pipe over the ridge and pump excess material to the west in deeper, unvegetated water. A diffuser will be used on the end of the pipe to prevent scour. There are two cabins that may be impacted.

PA 190 – Pump the maintenance material on top of the islands at each end of the ridge to increase their size to about 1,200 feet in diameter for bird use. The ICT decided that the 4 to 5 year interval between disposal operations, which was recommended in the PINS management plan, would be accommodated in the DMMP to the extent practicable. PA 189 could be an alternate site for some of the excess material.

PA 191 – Pump the maintenance material to the southeast side of Pelican Island in an existing small embayment to expand the southern end of the island. The intent is to expand the nesting area on the only nesting site for white pelicans in the Laguna Madre. When the island is at optimum size, future material can be pumped to PA 190 or PA 192. A training levee, which will be graded down after placement like all levees on PAs in the Congressionally authorized PINS boundary, will be placed on the southwest and south sides of Pelican Island to retain the material in the embayment and let excess material flow out on the southeast side to form a sloping beach.

2.11.2 Reach 2

This reach contains PAs 192 to 202. PAs 192, 194, and the northern half of PA 195 are also located inside the Congressionally authorized boundaries of PINS.

The ICT considered all of the alternative dredging and placement options described earlier in this section of the DEIS for the PAs in Reach 2. Following the criteria designed to identify fatal flaws in a disposal option, the ICT again recommended the elimination of ocean placement as a viable option due to the long haul distances, lack of appropriate equipment, and excessive pumping distances for pipeline disposal. One other option, piping the material across Padre Island was eliminated for Reach 2 because the PINS would not permit it, since this action would represent an impairment of natural resources in the Park. Likewise, Upland Confined and Upland Thin Layer Placement were eliminated from further consideration because of the permanent impacts to seagrass, serpulid reefs, and wetland habitats that would occur in pumping the material to an upland site. The required pumping distances also would require booster pumps, which would reduce efficiency. The only remaining options (fully confined, semiconfined, and unconfined open-bay placement) were analyzed for each PA in Reach 2 before determining the best option, given the unique combination of habitat, dredging frequency and volume, and environmental management plans proposed for each PA.

Because PAs 192, 194, and one-half of PA 195 are located inside the Congressionally authorized PINS boundary, the ICT reviewed the management plan prepared by the PINS for these PAs to determine compatibility with the DMMP. The disposal practices described in the PINS plans were incorporated into the DMMP to the extent practicable. Some of the limitations on disposal described in the PINS plan could not be incorporated due to type of material and dredging frequency or volume, but the ICT recommended that each PA management plan would be reviewed prior to dredging and placement to determine the best plan for that dredging cycle in coordination with the PINS personnel.

In the past, placement of maintenance material in this reach was strictly open-bay placement. Under the DMMP, three PAs include no changes from present practice, since dredged material at these PAs is presently placed in deep water containing no seagrass. One PA will be fully leveed and five others are scheduled for partial levees or training levees to control flow of the dredged material. Material will be placed on the emergent islands, using diffusers, on seven of the PAs; care will be taken to avoid circulation channels at five; and material will be pumped to deeper water to avoid seagrass at two other PAs. Five PAs are scheduled to take on a limited amount of material, with the excess pumped to nearby PAs; and five are scheduled to be expanded for bird use or seagrass avoidance. The impacts from the PA expansions are included in Section 4. The following is a summary of the actions proposed in the DMMP by PA.

PA 192 – Pump the maintenance material on top of the emergent thin mounds and the shallow areas, with frequent moving of the discharge pipe to stay on top of the string to increase the size of these islands for bird use, while minimizing impacts to seagrass.

PA 193 – Pump most of the maintenance material to the southeast side of the north island, gradually increasing the size of the island to the south, with the flow directed to the south. The north, west, and south boundaries of the PA will be moved out to include all of the islands for disposal use.

PA 194 – Pump the maintenance material on top of the island to increase the size of the island for bird use and use training levees to help retain the material and prevent additional shoaling of the surrounding shallow areas and minimize impacts to surrounding seagrass. An existing small pond will be recreated after disposal is compete if it has filled in with sediments.

PA 195 – Extend the boundary of the PA south to include the four islands, an oil company access channel, and east to include the turning basin since the intent is to fill the channel with dredged material. The maintenance material will be pumped on top of the islands and the flow directed to the south to increase the size of the islands for bird use, while minimizing impacts to seagrass. Two cabins may be impacted. The long-term effects of filling in the shallow area east of the PA must be determined since it may become piping plover critical habitat as it becomes emergent.

PA 196 – Confine the material on the island inside PA 196. To minimize short-term impacts to most of the cabins, use confining levees on the north, east, and south sides to hold material on that side and prevent seagrass burial there. Low training levees will be placed on the west side to hold most of the material flowing between the mounds on the island and build up the island. The cabin owners will be notified that they either need to raise their cabins or move them off the island. Over time the confining levees will be extended until the entire island is completely confined.

PA 197 – Establish at least three corridors over the northern islands and pump some of the dredged material over the mounds to build up the northern islands for bird use. By using each corridor in alternating cycles, each area would have a 6-year interval between disposal operations for the surrounding seagrass to recover. Most of the dredged material would need to be placed on the southernmost island during each dredging cycle to build it up for bird use. Much of the excess material will flow east into the deep, unvegetated water. Extend the east boundary about 500 feet to the east from the north end of the southern island to the south end to provide space to place the pipe and to include the potential footprint of the material flowing into the deep water. Two cabins located on the southernmost island are in the process of renewing their permits.

PA 198 – Continue with the current practice of unconfined disposal in the PA in deep, unvegetated water.

PA 199 – Shift the PA south to avoid the seagrass habitat and connect it to PA 200. All disposal of dredged material must be in the deep water area. There is a small channel between PAs 199 and 200. Fill it in with dredged material when the two PAs are combined.

PA 200 – Continue current practice of unconfined disposal of dredged material since there is no nearby seagrass habitat or bird use area to be impacted.

PA 201 – Continue the present practice of unconfined disposal, but limit the disposal to the middle submerged area of the PA to avoid the bird islands at each end of the PA.

PA 202 – Extend the levees of this emergent site south to the channel between PAs 202 and 203 and north along the emergent area as far as needed to confine all the dredged material over the next 50 years. The expansion may need to enclose some open water to provide enough capacity for the 50-year life of the DMMP.

2.11.3 Reach 3

This reach includes PAs 203-210, all located at upland sites in the Land Cut. Although PA 205 receives no maintenance material from the GIWW, the ICT recommended that it be consulted before use due to the PAs proximity to the GIWW. Since it is not used for placement of maintenance material from the GIWW, it is not part of the DMMP.

The ICT considered all of the alternative dredging and placement options described earlier in this section of the DEIS for the PAs in Reach 3. Following the criteria designed to identify fatal flaws in a disposal option, the ICT again recommended eliminating ocean placement as a viable option due to the long haul distances, lack of appropriate equipment, excessive pumping distances for pipeline disposal, and the prohibition against crossing the PINS. Open-Bay Disposal was also eliminated because the closest open-bay site is The Hole, which is a shallow, vegetated area that is a popular fishing destination. The ICT did not recommend taking any of the material to The Hole because of the impacts to seagrass and productive bay bottom that would accrue. Similarly, the Beach and Washover Nourishment options were eliminated for this reach because of the lack of sufficient sites to hold all of the dredged material and the prohibition against crossing PINS property with a pipeline. Thin Layer Placement was eliminated because of the lack of sufficient sites to hold all of the dredged material and because it would not enhance the upland (sand/mud flat) habitat, which is a goal of this option. The only remaining option (Upland Confined Placement) was analyzed for each PA in Reach 3 before determining the best management plan, given the unique combination of habitat, dredging frequency and volume, and environmental management plans proposed for each PA. In some cases, the ICT recommended that it was not necessary to completely confine a PA in this reach, as described below.

In the past, placement of maintenance material in this reach was into upland PAs, all but two of which are at least partially confined and all but three of which have some portion of the PA enclosed in full levees. Under the DMMP, all use of the PAs will continue with present practice, except that in the unconfined areas, the discharge pipe will be moved frequently to deposit only a thin layer of material to reduce the chances of flow outside the PA boundaries. Three of the PA boundaries will be expanded to include existing levees.

PA 203 – The southern end of PA 203 is fully leveed and encompasses about 108 acres. However, the front levee (nearest to the GIWW) may be outside the designated boundary of the PA and its current position will have to be documented in the DEIS. Move the dredge pipe frequently to deposit only a thin layer of dredged material in the unconfined portion of the PA until reaching the confined area and then place the rest in the leveed section.

PA 204 – Continue with the present disposal practice in this completely leveed PA. The front levee (nearest to the GIWW) may be outside the designated boundary of the PA and its current position will have to be documented in the DEIS.

PA 206 – The northern third of this PA is fully confined. The southern end has some training levees. However, the front levee (nearest to the GIWW) may be outside the designated boundary of the PA and its current position will have to be documented in the DEIS. Continue with the current disposal practice and maintain the training levees, if they still exist, in the southern end.

PA 207 – This PA is fully confined in the lower two-thirds of the site. Continue with the current placement practice but move the dredge pipe frequently to keep the dredged material runoff as thin as possible in the unleveed section.

PA 208 – This is a very long PA with short, leveed sections in the middle and southern end of the site. Continue the current disposal practice, but move the pipeline frequently to prevent excessive dredged material run-off at any one location in the unleveed sections. Keep the channels clear of any dredged material during disposal operations.

PA 209 – This is a short PA without levees. Same management plan as for PA 208.

PA 210 – This is a short PA with levees at the back and on the sides in the southern third of the site. The GIWW side is open. Continue the present disposal practice in the semiconfined area and move the dredge pipe frequently in the unleveed section.

2.11.4 Reach 4

This reach contains PAs 211–222. Because several of the sites are close to the mainland or an entrance channel, are located in deep, unvegetated water, or have special requirements for environmental management, each PA or group of PAs was considered separately when determining the best dredging option for the area.

In the past, placement of maintenance material in this reach was strictly open-bay placement. Under the DMMP, PAs 213–219 include no changes from present practice, since dredged material at these PAs is presently placed in deep water containing no seagrass. Three PAs will be expanded, one will be reduced in size to help predator control, one will be completely leveed, and three will have additional levees or baffle levees to control flow of the dredged material. One PA will be moved and include subsurface levees, and the impacts from this and the other expansions are included in Section 4. The following is a summary of the actions proposed in the DMMP by PA.

PA 211 and 212 – PA 211 has an earthen levee on the east side to prevent sediment flowing out into the seagrass on the backside of the site. PA 212 consists of a series of small islands paralleling the GIWW just south of PA 211. Move the existing earthen levees on PA 211 farther to the east and north, add baffle levees across the site to slow the sediment flow and allow more settling, and add earthen levees on the west side while leaving the south side open, thus creating a horseshoe-shaped disposal site.

For PA 212, remove the northernmost island and pile this material along with maintenance material on the next island to the south, creating a larger water gap between PAs 211 and 212. The islands in PA 212 would not be leveed to contain the dredged material, but would be managed for bird nesting by alternately disposing on one island during a dredging cycle and then on another island in the next cycle.

PAs 213–219 – These PAs are located on the east side of the GIWW in water too deep to support seagrass. Continue the present practice of using unconfined disposal at these sites, since there would be no significant biological benefits to be gained by trying to create a fully confined or semiconfined PA system in this area.

PA 220 – This L-shaped disposal site contains an emergent island located at the bend of the site, but much of it is outside of the boundary of the PA and is eroding severely on the north side.

An ocean placement alternative was considered for PAs 220 and 221 due to their frequent use and proximity to a pass. A bucket dredge and scow would be used to collect shoaled material from the GIWW near Port Mansfield Channel and taken offshore to a designated ocean disposal site. This alternative would be considered for future dredging cycles, provided it could be done economically, equipment was available, and EPA provided the necessary clearance for ocean disposal of the dredged material under Section 102 of the Marine Protection, Research and Sanctuaries Act.

The recommended management plan for this site would place geotubes on the shallow shelf around the existing island on three sides, leaving the south end open. Dredged sandy material from the Port Mansfield Channel would be stockpiled on the north side of the site and used to fill the geotubes later. Silty material in the GIWW from future dredging cycles would be used to fill in the horseshoe-shaped site surrounding the bird island to enhance bird nesting habitat. This would also protect seagrass near the site from burial and high turbidity to the north. The open southern end could be closed with geotubes later, if it is determined there is more erosion occurring there than is currently believed to exist. This alternative would require expanding the boundary of PA 220 beyond what is described in the 1975 EIS.

PA 221 – Move PA 221 to the east side of the GIWW. The new site would be known as PA 221A, but a linear arrangement of low geotubes or a levee created with in situ material (both subsurface) may be needed between the GIWW and PA 221A to prevent dredged material from flowing back into the GIWW.

An alternative consideration by the ICT would be offshore disposal using a bucket dredge and scows as described for PA 220. A determination will be made before each dredging cycle which alternative would be used based on ecosystem benefits and habitat needs, equipment limitations, disposal restrictions, and economics.

PA 222 – Extend the levees to the south and move the west levee farther out (in some areas, a short distance out into the water) to increase the size of the enclosed PA. Since PA 222 is surrounded by seagrass, this action will permanently remove a small area of seagrass on the western side of the PA, but the larger area of seagrass surrounding the PA would be protected from turbidity or future releases of dredged material in the nonleveed section of the PA. Increase the size of the gap between the large leveed island and the islands to the south (outside PA 222) by pulling in material at the gap to construct the south levee.

2.11.5 Reach 5

This is the shortest reach in the Laguna Madre and contains PAs 223 to 228.

The ICT considered all of the alternative dredging and placement options described earlier in this section of the DEIS for these PAs. Following the criteria designed to identify fatal flaws in a disposal option, the ICT recommended eliminating ocean placement as a viable option due to the long haul distances between Mansfield Pass and Brazos Santiago Pass, lack of appropriate equipment, and excessive pumping distances for pipeline disposal. One other option, piping the material across Padre Island was eliminated because of the distance involved and the unacceptable impacts to seagrass and extensive sand/mud flats between the GIWW and the barrier island. Likewise, Upland Confined and Upland Thin Layer Placement were eliminated from further consideration because of the permanent impacts to seagrass and wetland habitats that would occur in pumping the material to an upland site. Another factor affecting upland placement is that the LANWR owns the upland area on the mainland opposite PAs 224–234 and will not accept dredged material in the Refuge. The only remaining options (fully confined, semiconfined, and unconfined open-bay placement) were analyzed for each PA in Reach 5 before determining the best option, given the unique combination of habitat, dredging frequency and volume, and environmental management plans proposed for each PA.

In the past, placement of maintenance material in this reach was strictly open-bay placement. Under the DMMP, only two PAs include no changes from present practice, since one is almost never used and the other is fully leveed. All of the others will be expanded and fully leveed. The impacts from the expansion of the PAs are included in Section 4. The following is a summary of the actions proposed in the DMMP by PA.

PA 223 – Create a fully confined earthen levee at this PA to protect the seagrass beds in nearby shallow water. The islands are so narrow that the western levee will have to be placed a short distance out into the water to create a useable PA. This will permanently remove a small area of seagrass, but will benefit the large area behind the PA. The gap at the south end would be enlarged by pulling material from the narrow channel onto the island to create the south levee for the PA.

PAs 224 and 225 –These PAs are partially leveed but open on the west side. Fully confine the two sites to form one long PA with two cells. The USACE may still retain the original PA numbers for each site/cell.

PA 226 –This PA is fully confined by earthen levees. It is used to contain maintenance material dredged from both the Arroyo Colorado and the GIWW. This PA has the capacity to hold material from the GIWW segments normally designated for PAs 224, 225, 226, and 227, unless a severe storm strikes the area and causes excessive shoaling. At this time, it may become necessary to divert dredged material to the other PAs to avoid depleting capacity at this site. Use and manage as currently done by the USACE.

PA 227 – This PA is an unconfined site located opposite the GIWW from the Arroyo Colorado. There are no plans to use this PA, but the USACE reserves the right to use the site on an emergency basis. As part of the management plan, the USACE may also use the site if the island appears to be in danger of disappearing through erosion. Leave the disposal site as it is since there are no plans to use it at this time.

PA 228 – Create a fully confined earthen levee system on 6,000 feet of the longest chain of islands at the north end and place the west levee a short distance into the water to achieve a width of at least 700 feet. Another 5,000 feet of the island chain on the south end will also be fully leveed to provide sufficient capacity for the life of the DMMP. Trade-off a permanent loss of a small area of seagrass habitat to protect the much larger area of surrounding seagrass habitat. The USACE will determine the proper size of the PAs to be fully leveed and the best location for the levees.

2.11.6 Reach 6

This reach includes PAs 229 on the north end through 240 on the south end. Disposal options were examined for each PA separately, because several of the sites are close to the mainland or an entrance channel, are located in deep unvegetated water, or have special requirements for environmental management. Upland disposal on the mainland was not an option for PAs 224 through 234 because the LANWR owns the uplands.

In the past, placement of maintenance material in this reach was strictly open-bay placement. Under the DMMP, only the two southernmost PAs include no changes from present practice, since one of these sites is mostly confined and the other is small, rarely used, and mostly unvegetated. All of the others will continue to use unconfined open-bay placement, but five will have limitations on timing to avoid seagrass and nesting-bird impacts and some will have limitations on volume. Additionally, two of the sites will be moved into deeper water to avoid seagrass impacts and resuspension, which leads to increased dredging frequency. Material will be placed on the emergent islands, using diffusers, on two of the PAs. The impacts from moving those PAs are included in Section 4. The following is a summary of the actions proposed in the DMMP by PA.

PA 229 – Use the PA as in the past, but move the discharge pipe to the two or three spots available on nonvegetated mounds and let the material run out to the east. Dredging and disposal operations November through February, inclusive, when seagrass is dormant and birds are not nesting.

PA 230 – Use the site, if needed in the future, with seasonal restrictions for bird nesting and seagrass growth, after surveying for suitable discharge points to avoid seagrass and bird use areas, as much as possible, before each use.

PA 231 – Use the PA with the same restrictions as PA 230.

PA 232 – Continue placing dredged material at the current site, but spread it along the PA in as thin a layer as possible to limit the depth of seagrass burial, using a diffuser at the end of the pipe to reduce discharge energy and move the pipe frequently to facilitate thin layer placement. This plan will be reviewed before each dredging event to see if changes in the management plan are needed.

PA 233 – Move the disposal site farther west and south to deeper water (greater than 4.5 feet deep) to avoid seagrass and minimize the effects of the turbidity plume, designate as PA 233A.

PA 234 – Move this site about 1.5 miles to the west to join with PA 233A.

PA 235 – Use only for dredged material from the section of the GIWW for which it was established. This will allow sufficient time for seagrass to recover between cycles (9 years) and reduce the amount of material placed in the site. Disposal will take place during the November 1 to February 28 dredging window when seagrass is normally dormant and the dredge pipe moved frequently to prevent excessive build-up of material in any one location. Sandy material may be used to build up the mounds for more bird use in the future. Since the mounds are outside (west of) the boundary of the PA, the site will have to be expanded in the DEIS to include the mounds for beneficial placement of sandy material, if any is available.

PA 236 – Follow the same disposal procedure designated for PA 235, should it become necessary to use this site in the future.

PA 239 – Continue use of the present disposal practice.

PA 240 – Continue the present disposal practice in this semiconfined site, since it is seldom used and has little volume to flow out into shallow water.

2.11.7 Emmord's Hole

The modeling group from WES, which was conducting all hydrodynamic and sediment transport modeling for the project, examined the impacts should Emmord's Hole be used. The general location was determined from the region's bathymetry, based on the observation of Dr. Ken Dunton that seagrass is not likely to be found in the Laguna Madre below a depth of 4.5 feet. The rest of this paragraph is based on the information found in Chapter 9 of Teeter et al. (2002). The area is generally bounded by 27°26' to 27°35' N and 97°12' to 97°21' W and depths as great as 6.5 feet mean low low water (MLLW) are found in a some portions. The area below a depth of 5.7 feet MLLW is 420 acres, below a depth of 5.25 feet is 519 acres, below a depth of 4.9 feet is 2,050 acres, and below a depth of 4.1 feet is 5,755 acres. The area below a depth of 5.25 feet was chosen for disposal in the model run since it allowed assurance that there should be no seagrass there, as confirmed by field observations. The total amount of material deposited was the combined per-cycle amounts normally placed in PAs 186–189, or 555,400 cy of maintenance material. As noted, it was placed in the center of the area below a depth of 5.25 feet, and 70 percent of the placement, in the model, was laid onto the bed in a 24-hour period in early October, while the remaining 30 percent was injected into the water column at the same location over the following 5 days. The footprint of the bed placement was a 519-acre oval, roughly 6,300 feet long in the north-south direction and 3,600 feet in the east-west direction (see Figure 9.5, Teeter et al., 2002). Within 820 feet of the edge of the footprint, dredged material deposition depth was less than 0.4 inches. For the rest of the month of October, TSS was elevated above the no-disposal scenario about 13 mg/L in an area 9.3 miles north and 2.5 miles east. The 20 percent isopleth was displaced north 7.5 miles, on to seagrass beds, and east up to 0.6 miles, which carried it across the GIWW. During the remainder of the year, monthly average TSS values increased by no more than 7 mg/L and the 20 percent isopleth was displaced only around 500 feet, which does not reach seagrasses. Comparing the model runs with empirical data, Teeter et al. (2002) found TSS elevated within 985 feet of the discharge point in sampling in the Upper and Lower Laguna Madre in 2000. The model indicated TSS elevation of 26 mg/L roughly 1,150 feet north and south of the discharge point. Of course, the model put a much larger amount of material on the bed than occurs in actual dredging and can, therefore, be considered conservative. Based on a 3-year cycle, Teeter et al. (2002) determined that the useful life of Emmord's Hole, for all material normally placed in PAs 186–189, would be 183 years.

The DMMP includes only PAs 184–188 as potentially using Emmord's Hole as an alternative PA, which was not known when the modeling was initiated, since the DMMP was not completed at that time. The model used only 80 percent of the 696,300 cy that is the total per-cycle amount of material from the PAs 184–188. However, Emmord's Hole is not intended to completely replace these PAs, but to only act as a placement location of last resort when dredged material normally designated for PAs inside the Congressionally authorized PINS boundary is moved to these PAs. This will prevent an overload of material at these PAs that could affect nearby seagrass beds that are not usually affected by current placement practices. The ICT will review this issue prior to use and make recommendations to the USACE for managing the material in the area. Additionally, the frequency of PAs 186–189 used in the model was roughly 3 years, while the average frequency of PAs 184–188 used in the maintenance program is 6.2 years, ranging from 3.3 years for PA 188 to 11.6 for PA 184. In any case, Emmord's Hole will only be used for placement when the ICT recommends it be used because of necessity.

2.12 REFINED COST ESTIMATE

2.12.1 Introduction and Methodology

Several different alternative methods for dredging and placement of the shoaled material in the GIWW were identified. This was all provided to Moffatt & Nichol Engineers (Moffatt & Nichol), under contract to the USACE, to perform detailed cost estimates utilizing the Cost Engineering Dredge Estimating Programs (CEDEP). The purpose of the cost estimates was to obtain a comparative analysis or "relative difference" between the alternatives and to allow the USACE to determine whether any alternative is not economically feasible.

The cost estimate for each alternative included the mobilization and demobilization of equipment (mob/demob), daily plant costs (i.e., dredge, pipeline, and all support equipment) fuel, and labor costs. Site preparation costs were determined, where necessary, and added to the dredging costs to obtain a total unit cost and total 50-year costs for each alternative.

Delay times due to barge traffic, adverse weather conditions, and other factors are based on data from previous dredging projects that have occurred throughout the Laguna Madre portion of the GIWW. Daily dredge logs from previous dredging projects, vessel traffic records from 1995–2000, and meteorological information for the Lower Laguna Madre were used to determine historical downtime summaries. This information was compiled and used to produce a table in which were calculated the travel speeds for the hopper dredges, tugboats, and dump scows that were carried through all estimates in the appropriate alternatives.

All dredging volume estimates were based on an analysis of the data provided in Table 2-33, which is a compilation of dredging records for the GIWW in the Laguna Madre from November 1948 to April 1995 (46.4 years). This information was provided by the USACE and was used to determine per-cycle discharge quantities, per-cycle dredging areas, shoaling rates, number of dredging episodes, and the sand content of the dredged material. Based on these historical records, an average dig face for the dredge cutterhead was determined for each Reach of the GIWW throughout the Laguna Madre. The USACE provided the contractor overhead, profit, and bond rates to include in the dredge costs. The USACE also provided the contingency, design, construction management, and administration rates.

Equipment cost factors, area factors, and economic indexes were derived from the U.S. Army Corps of Engineers Construction Equipment Ownership and Operating Expense Schedule, Region VI, EP 1110-1-8 (Vol. 6), 31 Aug. 01.

Prior to beginning the estimates, a survey of the U.S. dredging fleet was accomplished to determine what dredge plant was available to perform the work. Several different types of dredging equipment were surveyed, including hopper dredges, cutterhead dredges, and clamshell dredges with dump scows. Several industry publications and a dredging industry monthly report were utilized for the dredging fleet survey. From the survey, it was established that a sufficient number of cutterhead dredges and smaller clamshell dredges (<10 cy) were available in the Gulf Coast region. It was also found that a majority of the hopper dredging work occurs on the Southern Atlantic, Gulf Coast, and Lower Mississippi River system of the U.S. By using New Orleans as the mobilization point, it allowed for adequate competition from all of the Gulf fleet dredges.

During the course of the dredging fleet analysis, it was determined that there are only three hopper dredges in the U.S. fleet with a sufficiently shallow draft to work in the GIWW. Of the three hopper dredges, one has currently been sold to an overseas firm and taken out of the country. This leaves only two viable hopper dredges to perform the work.

The assumptions that were used during performance of the cost estimates are given below. The general assumptions that were used on all alternatives estimates are listed first, with a brief explanation. Following the general assumptions are the different alternative estimates and any general or specific assumptions that were pertinent to the estimates for a given alternative or sub-alternative.

2.12.2 General Assumptions for All Alternatives

Estimates were determined for each Reach used by the ICT, except for special cases that were determined by specific segments to remain consistent with the preliminary alternative analysis and preliminary cost estimates that had been performed (Sections 2.3 through 2.10) and to keep the number of estimates reasonable. The assumptions were kept consistent throughout all estimates so the alternative costs could be compared on an equal basis.

- All dredging and site preparation costs assume a 50-year project life.
- The dump scows located on the West Coast were not included in the idle scow location calculations because of the long distances required to transport the equipment to the project site and the short dredging durations.
- No foreign fleet vessels can be used because of the Jones Act (U.S. Code Title 46, Appendix, Chapter 12, Section 292).
- The wage rates are based on contractor payroll information from previous dredging projects.
- The mob/demob costs for all hydraulic dredges, hopper dredges, and smaller clamshell dredges (<10 cy) are based on equipment being mobilized to the project site from as far away as New Orleans (approximately 600 miles). The demobilization costs are based on the equipment being demobilized and stored at Corpus Christi.
- The mob/demob costs for the hydraulic dredge estimates were revised for each estimate depending on the length of pipeline and the number of booster pumps necessary to complete the work.
- No real estate acquisition fees or rights-of-way for areas where the discharge pipeline crosses private properties were determined for any of the upland alternatives or offshore alternatives
- No environmental constraints, environmental impacts, or other resource impacts were considered during the development of the cost estimates.
- No costs associated with an Ocean Dredged Material Disposal Site (ODMDS) EIS or permitting were determined during the development of the cost estimates nor included in the estimates.

2.12.3 Alternative 1: Current Method

Alternative 1 is the present practice for maintenance dredging of the GIWW through the Laguna Madre. A cutterhead dredge places the material, via pipeline, into the established open-water PAs in Reaches 1, 2, 4, 5, and 6. The established PAs for Reach 3 are upland confined or semiconfined sites. The open-water PAs are spaced throughout the project length, so that the maximum pumping distance for the cutterhead dredges is approximately 5,000 feet, negating the need for booster pumps.

Given that this is the No-Action alternative, Alternative 1 will serve as the basis for comparison with the other alternatives.

2.12.3.1 Assumptions General to Alternative 1

Alternative 1 requires no general assumptions except those common to all alternatives.

2.12.3.2 Specific Assumptions

- The estimates for Alternative 1 utilize a 20-inch Hydraulic Cutter-Suction Dredge.
- The material is discharged into the existing open-water PAs.
- No levee work was assumed for the existing open-water PAs that are semiconfined or confined.
- Reach 3 is based on placement at the existing upland sites.
- The estimate for Reach 3 assumes shore/levee work associated with the upland sites only during each dredging cycle.

2.12.4 <u>Alternative 2: Offshore</u>

Alternative 2 calls for maintenance dredging and placement offshore. Dredged material would be placed at the current designated ODMDSs located near the Mansfield Pass or Brazos Santiago Pass, or pumped 2 miles offshore from the barrier island. Various dredging and placement methods were considered, including hopper dredges, cutterhead dredges pumping into dump scows, clamshell dredges with dump scows, and cutterhead dredges by pipeline.

Prior to performing the hopper dredge estimates for Alternative 2, several questions were raised by the ICT regarding the operation of hopper dredges in the GIWW (sub-alternatives 2A1 and 2A2): could hopper dredges back down the GIWW to the passes rather than making a loop between two passes, could commercial tug and barge traffic safely pass hopper dredges working in the GIWW, and would hopper dredges working in the GIWW be restricted to one-way traffic or could they safely pass each other. Captain Carl E. Bowler, a Master Mariner/Ship Pilot with 26 years' experience, was engaged to determine the viability of hopper dredges working in the GIWW relative to the above questions.

Captain Bowler spoke with local towing companies, the director of the Gulf Intracoastal Canal Association, hopper dredge owners, and the Commander of USCG District 8 regarding the use of hopper dredges in the GIWW. Based on the above conversations and his own practical experience piloting vessels of this size and larger, Captain Bowler determined that it would be infeasible and unsafe for a hopper dredge to back down any considerable distances in the operating conditions present in the GIWW. Therefore, without turning basins being created, the hopper dredges would need to make a loop between two offshore passes, adding long transit distances to the project.

Relative to commercial tug and barge traffic safely passing the hopper dredges and hopper dredges passing each other, it was determined that this was feasible if weather conditions permitted. However, the hopper dredge would have to discontinue work and move to the edge of the channel to allow commercial traffic and other hopper dredges to pass safely. An increase in vessel traffic created by additional hopper dredges could potentially cause delays to normal vessel traffic flow.

Another option for Alternative 2 (sub-alternatives 2B1 and 2B2) was to use dump scows to transport the dredged material to offshore disposal sites. The important issue with these two sub-alternatives was the availability of clamshell dredges and dump scows capable of performing the work. Based on several dredging industry surveys, taken from different periods of the year, the idle capacity of the dump scow fleet was established. The quantity, location, and ownership of the various dump scows in the U.S. fleet were then compared with the optimum quantity required to perform the dredging work. An estimated percentage of the idle dump scow fleet, for each sub-alternative was then calculated. In addition, the number of scows utilized was varied, to compute the effect on the dredging costs when less than optimum scow capacity was used. This allowed for a determination of how many dredging contractors possessed a sufficiently large idle scow capacity to perform the dredging work. It was concluded that only one dredging company owned sufficient idle fleet capacity to bid the work for any of the sub-alternatives that required more than three dump scows (Table 2-34).

To determine the effect on cost of single bidder projects versus multiple bidder projects, a study of USACE dredging contracts awarded from 1992–2001 was undertaken. The final bid percentage relative to the government estimate was compared for dredging projects with multiple bidders to dredging projects with single bidders. For the Galveston District, it was found that single-bidder projects averaged 15 percent over the government estimate while multiple bidder projects (three bids received) averaged 18 percent under the government estimate (Figure 2-1). A single-bidder scenario could potentially escalate the cost of the dredging work by 30 percent or more above a multiple-bid scenario.

In addition to the idle scow capacity resource analysis, the location of the idle dump scows in the U.S. fleet was also determined. Based on industry reports, the distance to the project site from the different idle scow locations was calculated. A weighted-average distance was then used to determine the cost to mobilize the required number of dump scows to the project site for each sub-alternative.

The general assumptions for Alternative 2 are listed below followed by specific assumptions related to the different sub-alternatives.

2.12.4.1 Assumptions General to Alternative 2

- All estimates for Alternative 2 that utilize dump scows working in the main channel of the GIWW utilize a 1,600-horsepower (hp) tugboat instead of a workboat. This is required because the dump scow will need to be moved to allow barge and other commercial boat traffic to navigate past the work areas. While the dump scow is alongside the dredge or spider barge, there is not enough room for commercial traffic to safely navigate past the work area.
- It was assumed that larger clamshell dredges (>10 cy) and dump scows were mobilized from the East Coast, based on the resource demand analysis that was performed.

TABLE 2-34

DUMP SCOW COMBINATIONS

No. of Scows Utilized (ea.)	Total Scow Capacity (CY)	Production Rate (CY/HR)	Operating Time (Hrs/Mo)	Total Idle Scow Capacity (CY)	Percent of Idle Scow Capacity	Optimal Haul Distance (Mi.-One Way)	Actual Haul Distance (Miles-RT)	Likely No. of Bidders (ea.)
Alternative #2B1: Offshore - Hydraulic/Scow								
7	28,000	1865	437	53,150	52.68%		16.53	1
6	24,000	1,865	364	53,150	45.16%		16.53	1
5	20,000	1,865	291	53,150	37.63%		16.53	1
4	16,000	1,865	218	53,150	30.10%		16.53	1
3	12,000	1,865	145	53,150	22.58%		16.53	2[3]
2	8,000	1,865	72	53,150	15.05%		16.53	2
Alternative #2B2: Offshore - Clamshell/Scow								
3	9,000	893	459	74,280	12.12%	16.60	16.53	2
2	6,000	893	230	74,280	8.08%	7.25	16.53	3[4]
Alternative #5A1: Special Cases - PA 220 & 221 (Offshore - Hydraulic/Scow)								
4	16,000	1,300	563	53,150	30.10%		9.99	1
3	12,000	1,300	374	53,150	22.58%		9.99	2[3]
2	8,000	1,300	187	53,150	15.05%		9.99	2
Alternative #5A1: Special Cases - PA 220 & 221 (Offshore - Clamshell/Scow)								
3	9,000	734	459	74,280	12.12%	20.50	11.63	2
2	6,000	734	380	74,280	8.08%	9.25	11.63	3[4]
Alternative #5B1: Special Cases - PA 233 & 234 (Offshore - Hydraulic/Scow)								
7	28,000	1,896	401	53,150	52.68%		17.33	1
6	24,000	1,896	334	53,150	45.16%		17.33	1
5	20,000	1,896	267	53,150	37.63%		17.33	1
4	16,000	1,896	200	53,150	30.10%		17.33	1
3	12,000	1,896	133	53,150	22.58%		17.33	2[3]
2	8,000	1,896	66	53,150	15.05%		17.33	2
Alternative #5B1: Special Cases - PA 233 & 234 (Offshore - Clamshell/Scow)								
4	12,000	893	459	74,280	16.16%	25.90	17.33	2
3	9,000	893	441	74,280	12.12%	16.60	17.33	2
2	6,000	893	221	74,280	8.08%	7.20	17.33	3[4]

Notes:

1.) Clamshell estimates utilize all dump scows greater than 1,500 CY capacity.
2.) All hydraulic estimates utilize all dump scows greater than 3,000 CY capacity.
3.) Second bidder would be a joint venture between Weeks Marine and Norfolk Dredging.
4.) The third bidder could be made up of a combination of C.F. Bean Corporation and Norfolk Dredging (for clamshell dredging).
The third bidder could be made up of a combination of Norfolk Dredging and Don Jon Marine,
or Norfolk Dredging and C.F. Bean Corporation (hydraulics pumping into scows).
5.) The idle scow capacity was determined from a dredging industry survey.
6.) There was an average of 3 bidders for dredging projects located in the GIWW, for the years 1990 to 2000.
7.) All site prep estimates involving clamshell work to dredge out access channels utilize a 10 CY clamshell dredge with 2 each 3,000 CY dump

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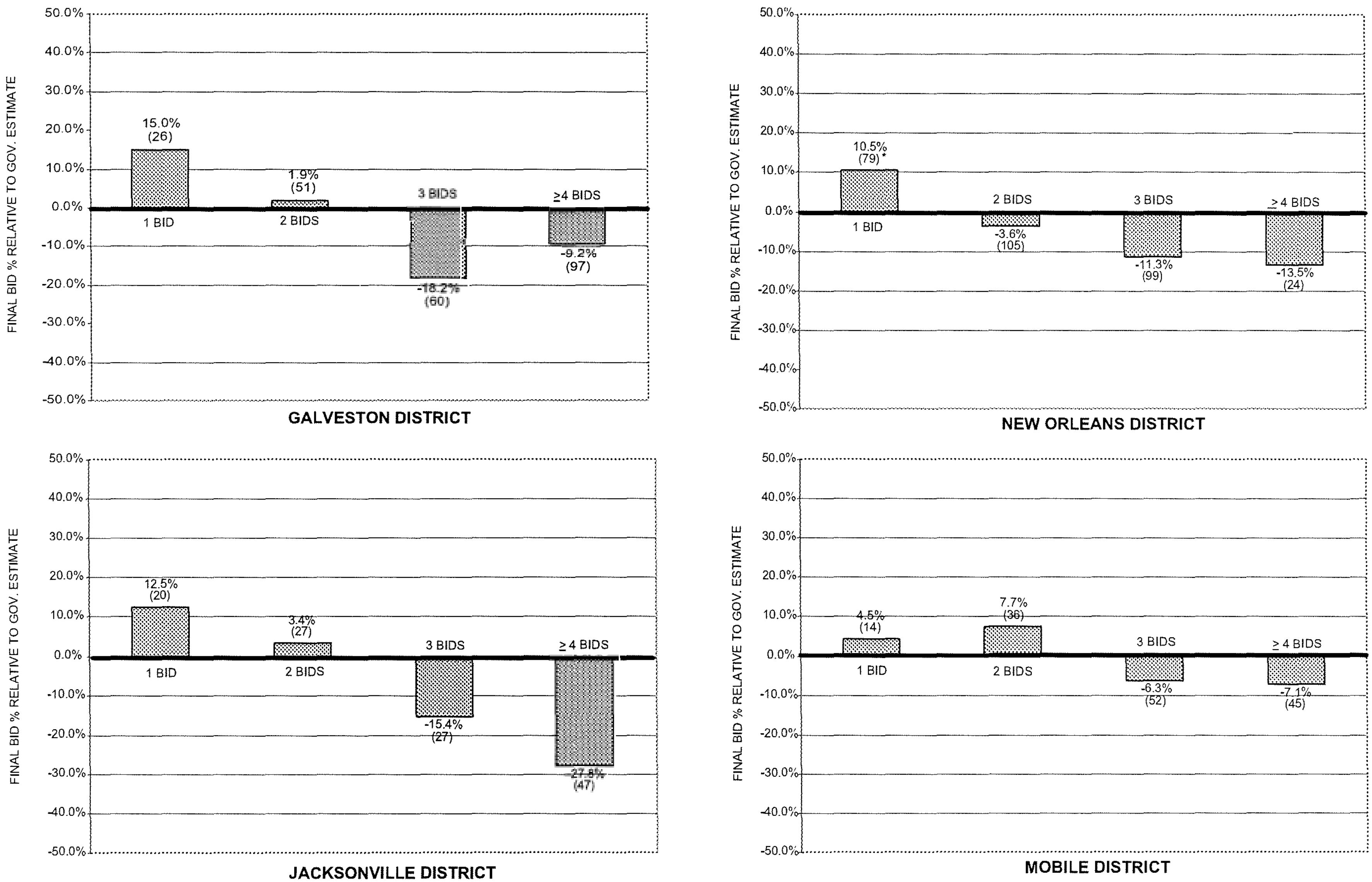
Figure 2-1
COST ANALYSIS VERSUS NUMBER OF BIDS



Source: Moffat & Nichol Engineers

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- The mob/demob costs for the clamshell estimates were revised for each estimate depending on the number of dump scows and tugboats that were needed.
- The hopper dredge and dump scow capacities were reduced to account for a draft limitation of 10.5 feet due to shoaled conditions in the GIWW.
- Unlimited overflow is permitted from the hopper dredges and dump scows during loading operations. No constraints due to water quality were taken into account, thus no costs were included for this.

2.12.4.2 Alternative 2A1: Offshore – Hopper Dredge w/Turning Basins (Reach 6 only)

- Alternative 2A1 assumes a turning basin is located at the north end of each segment in Reach 6 to reduce the distance and travel time for the hopper dredge. Due to the large differences in dredging frequency for the different segments within each reach, it was determined that each segment would need a turning basin to keep transit times as short as possible.
- Turning basins are 310 feet in diameter, dredged to a depth of –16 feet, and centered over the GIWW (Figure 2-2). This is based on the requirements of USACE and U.S. Navy engineering design guide manuals.
- The turning basin dredge quantities within the GIWW channel limits are deducted from the GIWW total dredging quantities.
- The dredged material is placed at the BIH ODMDS.
- The turning basins are dredged by a 10 cy clamshell dredge with dump scows prior to each cycle of GIWW dredging. Material is placed at the BIH ODMDS.
- All costs for dredging the turning basins are included in the site preparation costs.
- The turning basins are not maintained on a yearly basis but are dredged prior to each cycle.
- Shoaling rates for turning basins are based on shoaling rates determined for the different reaches of the GIWW from previous dredging records.

2.12.4.3 Alternative 2A2: Offshore – Hopper Dredge without Turning Basins (Reach 6 only)

- Alternative 2A2 assumes no turning basins are available for the hopper dredge.
- The hopper dredge will travel in a loop and dispose of the dredged material at the Port Mansfield ODMDS and then at the BIH ODMDS, etc.

2.12.4.4 Alternative 2B1: Offshore – Hydraulic/Scow (Reach 6 only)

- Alternative 2B1 is based on utilizing a hydraulic cutterhead dredge to pump the dredged material, via pipeline, to a spider barge, which loads the material into dump scows. The dump scows are then transported by tugboat, to the ODMDSs.

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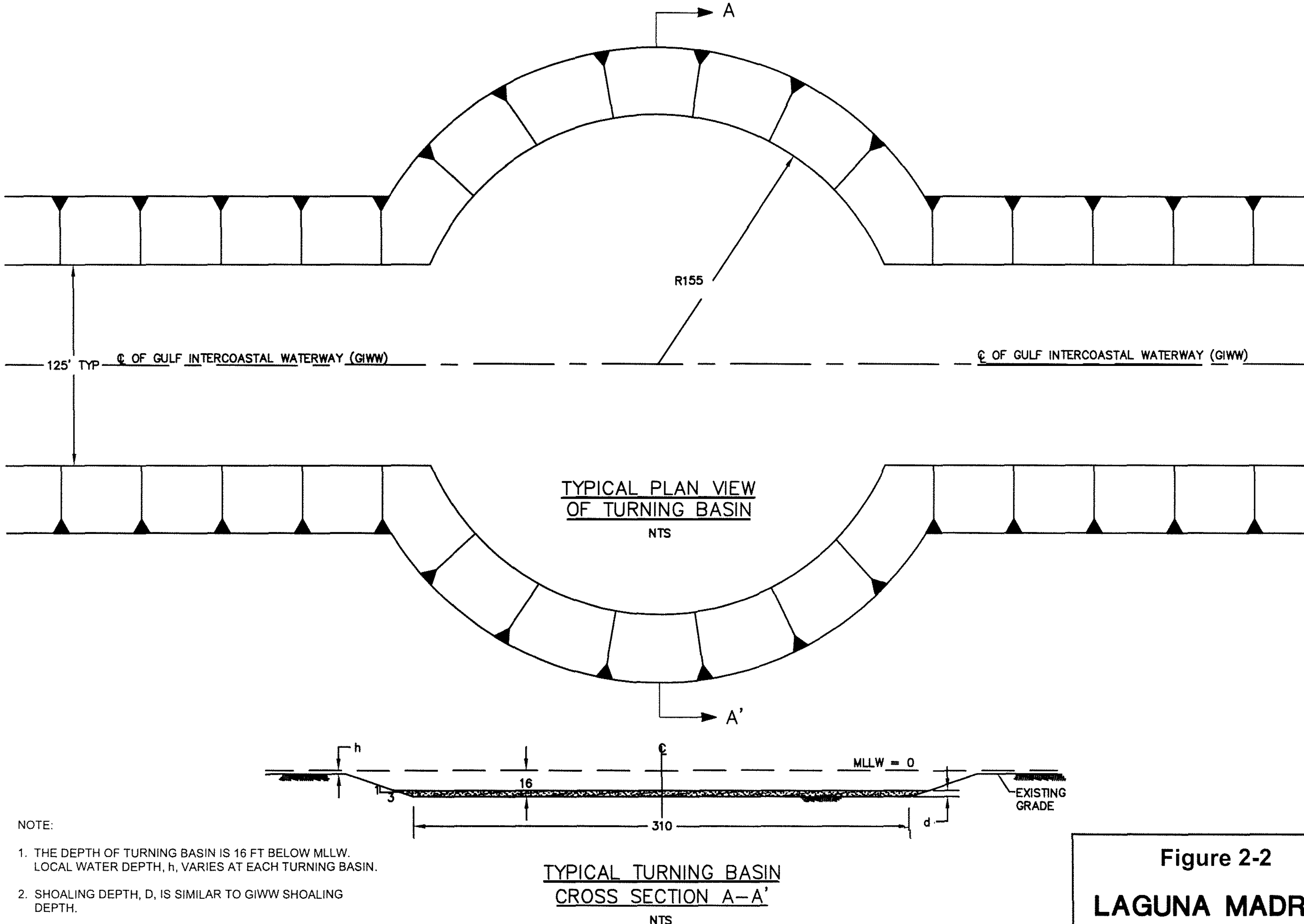

NOTE:

1. THE DEPTH OF TURNING BASIN IS 16 FT BELOW MLLW. LOCAL WATER DEPTH, h, VARIES AT EACH TURNING BASIN.
2. SHOALING DEPTH, D, IS SIMILAR TO GIWW SHOALING DEPTH.

Source: Moffat & Nichol Engineers

Figure 2-2

LAGUNA MADRE

TYPICAL TURNING BASIN

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- Alternative 2B1 assumes a pipeline length of 5,000 feet leading to the spider barge.
- The effective capacity of the scow is reduced to account for the material type and the large water volume produced by the hydraulic cutterhead dredge.
- Due to the narrow channel widths, the spider barge is only able to load from one side. The dredge would discontinue pumping material during dump scow change outs.
- Based on loading times, only 3,000 cy scows and larger were utilized.

2.12.4.5 Alternative 2B2: Offshore – Clamshell (Reach 6 only)

Alternative 2B2 assumes a 26 cy clamshell dredge.

The average size scow utilized for the estimate was a 3,000 cy scow.

2.12.4.6 Alternative 2C: Offshore – Hydraulic (2 miles offshore)

- All estimates for Alternative 2C assume an 8-foot-deep channel from the GIWW to Padre Island to allow for the pipeline and booster pump(s).
- There are no possible pipeline corridors for Reaches 2, 3, and most of 1 and 4 due to the PINS. Only areas of Reach 1 and 4 that were outside the Congressionally authorized boundaries of the Padre Island National Seashore were estimated.
- The pipeline channels are dredged by a 10 cy clamshell dredge with dump scows prior to each cycle of GIWW dredging and material dredged is placed at the ODMDSs.
- For Reaches 1, 4, and 5, it is assumed that the pipeline access channel will shoal back to its original condition prior to the next cycle of dredging. For Reach 6, it is assumed that the pipeline access channel will never shoal in any greater than its original condition.
- All rights-of-way and/or easements will be obtained for placing the pipeline across Padre Island, thus no costs were included for this.
- Culverts or pipeline tunnels will be provided to cross any streets or public right-of-ways on Padre Island, thus no costs were included for this.
- The pipeline will be buried in areas of beach access, but no costs were included for this.

2.12.5 Alternative 3: Upland

Alternative 3 is based on maintenance dredging by cutterhead dredge and transporting the material, via pipeline, to designated upland locations within each segment. For Alternative 3A, the upland locations are completely confined by earthen levees built with on-site borrow material. For Alternative 3B, the upland sites consist of thin-layer placement (1 foot thick) of the dredged material at the upland locations.

2.12.5.1 Assumptions General to Alternative 3

Alternative 3 requires no general assumptions except those common to all alternatives.

2.12.5.2 Specific assumptions:

- The levee quantities for the upland sites located in each segment were combined to get a total levee volume to be constructed within each Reach.

- There is no road access to the upland sites. All equipment access will be from channels dredged from the GIWW to shore locations near the upland sites.

- All rights-of-way have been obtained from the shoreline to the upland confined locations, thus no costs were included for this.

- A weighted-average, based on the dredging volumes for each segment, is used to determine the pipeline distances for each Reach.

- The size of each upland confined site is based on levees built to 30 feet in height to contain 50 years of dredged material. The levees are constructed utilizing on-site borrow material (Figure 2-3). All levees assume 2 feet of freeboard and 2 feet of ponding.

- PBS&J provided the theoretical locations of the 14 new upland sites for Reaches 1, 2, 4, 5, and 6. Reach 3 uses the existing upland sites for containment. The upland site sizes varied from approximately 30 to 510 acres. The approximate total acreage (measured from the outside toe of levee) for all 14 sites was 2,332 acres.

- All site preparation estimates for Alternative 3 assume an 8-foot-deep channel from the GIWW to the shoreline near the new upland sites to allow for equipment access to build the levees and also to provide access for the pipeline and booster pump(s).

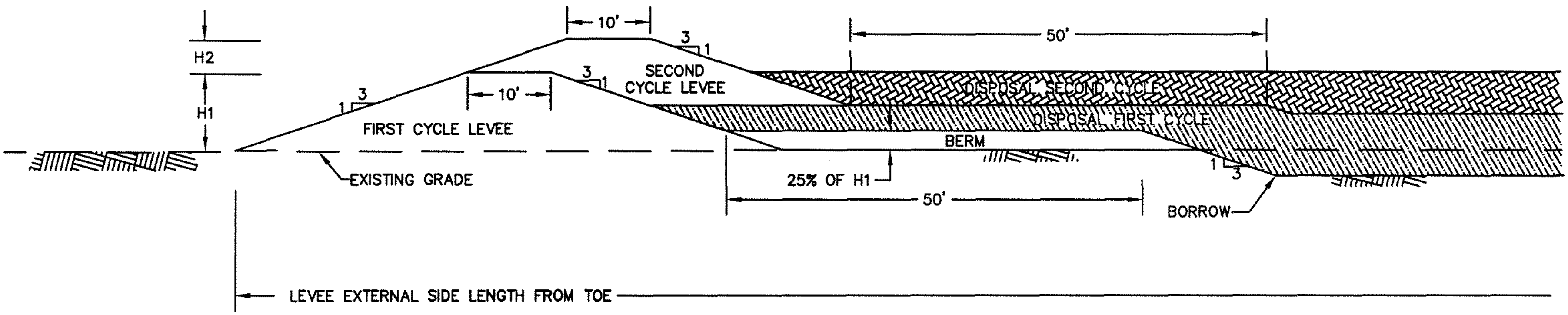
- Since the estimate for Reach 3 utilizes the existing upland placement sites currently available, no access channel dredging is necessary.

- The site preparation estimate for Reach 3 assumes that the existing confined and semiconfined PAs will be completely confined. The external size of the PA is assumed to be the size provided by the USACE for the existing PAs. Confinement levees were built around areas of the existing PAs that are not currently confined.

- Access channels are dredged by a clamshell dredge with dump scows prior to each cycle of GIWW dredging and placed at the ODMDSs.

- The effective capacity of the scow is reduced to account for the material type and limited depth of 8 feet.

- The mobilization costs were increased to allow for transport of the scows from the East Coast.



UPLAND PLACEMENT AREAS
TYPICAL SECTION
NTS

NOTE:

1. ALL DIMENSIONS SHOWN ARE TYPICAL
2. ACTUAL LEVEE HEIGHT AND DISPOSAL DEPTH DEPEND ON SEGMENT AND CYCLE

Source: Moffat & Nichol Engineers

Figure 2-3

LAGUNA MADRE

UPLAND PLACEMENT AREA

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- The access channels to the upland sites are not maintained on a yearly basis. Dredging of the access channel will occur prior to each dredging cycle (to allow access for equipment to construct levees).

- The shoaling rates for the access channels are based on the shoaling rates determined for the different reaches of GIWW.

2.12.6 Alternative 4: Open Bay

Alternative 4 is based on maintenance dredging by cutterhead dredge and placement, via pipeline, at the existing PAs alongside the GIWW. The limits of the existing PAs were provided by the USACE. Alternative 4A is identical to the current method. Alternative 4B is based on confining the existing PAs with levees to contain the material inside the PA. Alternative 4C is based on semi-confinement of the existing PAs to direct the flow of the dredged material away from the GIWW.

The confinement levees and associated costs for Alternatives 4B and 4C are based on conceptual levee cross sections that were developed by Shiner Moseley and Associates, Inc. for the USACE. The different levee sizes are based on the water depths that occur at each PA. Where existing islands occur within a PA, earthen levees were built from on-site borrow material. Locations that involved levees being placed in open-water were based on the conceptual levee sections, consisting of side-cast levees, gravel toe levees, or geotubes, all of which would be armored with graded riprap or articulating block mats. The site preparation costs for each PA are based on constructing the lower armored section of the levee first, then constructing the earthen expansion section of the levee in stages, prior to each cycle of GIWW dredging, up to the height required to contain 50 years of dredged material.

2.12.6.1 Assumptions General to Alternative 4

Alternative 4 requires no general assumptions except those common to all alternatives.

2.12.6.2 Specific assumptions:

- The dredged material is placed at the existing open-water PAs with the required containment levees.
- The levee quantities for the different open-bay confined and open-bay semiconfined PAs were combined to get a total levee length or volume to be constructed within each Reach.
- Reach 3 was not included in any of the estimates for Alternative 4. Reach 3 was completely confined in Alternative 3.
- A weighted-average, based on the dredging volumes for each PA, was used to determine the pipeline lengths for each Reach.
- Based on water quality constraints, the minimum PA size for 50-year containment was 80 acres or the entire existing PA, if the site was smaller than 80 acres.

- All levee sections were built up to the height required to contain 50-years of dredged material. All fully confined levees assume 2 feet of freeboard and 2 feet of ponding.

- The semiconfined levee sections are built around three sides of the PA and direct the flow of sediments away from the GIWW directly after dredging, while retaining some of the dredged material.

- The semiconfined levees are not required to contain, dewater and elevate the dredged material, so the final levee height is considerably less than the fully confined levees.

- The site preparation costs are based on the lowest cost conceptual levee section alternative (i.e., rock dike, geotube, or earthen levee).

- The weir design and costs are based on information provided by the USACE.

2.12.7 Alternative 5: Special Cases

The estimates for Alternative 5 are special case scenarios that deal with high dredging volume, high frequency of use PAs that are near the passes to the Gulf. Similar to Alternative 2, the material is placed at the ODMDSs located near the Mansfield and Brazos Santiago Passes. The dredging and placement is evaluated using several different methods, including hopper dredges, cutterhead dredges pumping into dump scows, clamshell dredges with dump scows, and cutterhead dredges by pipeline. The same issues/assumptions that are pertinent to Alternative 2 are also relevant for Alternative 5, such as the need for turning basins for the hopper dredges, the idle fleet capacity for the scenarios that utilize dump scows, varying the number of scows to determine the effect on costs, and the likely number of bidders based on the resource demand analysis.

2.12.7.1 Assumptions General to Alternative 5

- All estimates that utilize dump scows working in the main channel of the GIWW utilize a 1,600-hp tugboat instead of a workboat. This is required because the dump scow will need to be moved to allow barge and other commercial boat traffic to navigate past the work areas. While the dump scow is alongside the dredge or spider barge, there is not enough room for commercial traffic to safely navigate past the work area.

- It was assumed that larger clamshell dredges (>10 cy) and dump scows were mobilized from the East Coast, based on the resource demand analysis that was performed.

- The mob/demob costs for the clamshell estimates were revised for each estimate depending on the number of dump scows and tugboats that were needed.

- The hopper dredge and dump scow capacities were reduced to account for a draft limitation of 10.5 feet due to shoaled conditions in the GIWW, with the exception of Alternative 5A1-4-01 which loads the scows in deeper water.

- Unlimited overflow is permitted from the hopper dredges and dump scows during loading operations. No constraints due to water quality have been taken into account, thus no costs were included for this.

2.12.7.2 Alternative 5A1-4-01 and 5B1-5-01: Offshore – Hydraulic/Scow

- Alternative 5A1-4-01 is for PAs 220 and 221. Alternative 5B1-5-01 is for PAs 233 and 234.
- Alternative 5A1-4-01 assumes the scows are loaded in the deeper water of the Port Mansfield Channel, therefore the channel depth does not limit the scow draft.
- The effective capacity of the scow is reduced to account for the material type and the large water volume produced by the hydraulic dredge.
- Due to the narrow channel widths the spider barge is only able to load from one side. The dredge would discontinue pumping material during dump scow change outs.
- Based on loading times, only 3,000-cy scows and larger were utilized.

2.12.7.3 Alternatives 5A1-4-03 and 5B1-5-02: Clamshell – Offshore

- Alternative 5A1-4-03 is for PAs 220 and 221. Alternative # 5B1-5-02 is for PAs 233 and 234.
- Alternatives 5A1-4-03 and 5B1-5-02 assume a 26-cy clamshell dredge.
- The effective capacity of the scow is reduced to account for the material type and limited depth.
- The average size scow utilized for the estimate was a 3,000-cy scow.

2.12.7.4 Alternative 5A2, 5B2, and 5C1: Hopper w/Turning Basins

- Alternative 5A2 is for PAs 220 and 221. Alternative 5B2 is for PAs 233 and 234. Alternative 5C1 is for Reaches 4, 5, and 6 in the Lower Laguna Madre (LLM).
- Alternative 5A2 assumes a turning basin for the hopper dredges is located at the north end of PA 220 and the south end of PA 221.
- Alternative 5B2 assumes one turning basin is located at the north end of PA 233.
- Alternative 5C1 assumes a turning basin is located at the north end of each segment in each reach, except segment 13 (Figure 1-1).
- Turning basins are 310 feet in diameter, dredged to a depth of –16 feet, and are centered over the GIWW (Figure 2-2). This is based on the requirements of USACE and U.S. Navy engineering design guide manuals.
- The turning basin dredge quantities that are within the GIWW channel limits are deducted from the GIWW total dredging quantities.
- The turning basins are dredged by a clamshell dredge prior to each cycle of GIWW dredging and the material placed at the Port Mansfield or BIH ODMDS.
- The costs for dredging the turning basin are included in the site preparation costs.

- The turning basins are not maintained on a yearly basis but are dredged prior to each cycle of GIWW dredging.
- The shoaling rates for turning basins are based on shoaling rates determined for the different reaches of the GIWW.

2.12.7.5 Alternative 5A3 and 5B3: Hydraulic – Offshore

- Alternative 5A3 is for PAs 220 and 221. Alternative 5B3 is for PAs 233 and 234.
- Alternative 5A3 assumes that the pipeline runs out the Port Mansfield Channel and 2 miles offshore. There are no site preparation costs for this estimate.
- Alternative 5B3 assumes an 8-foot-deep channel from the GIWW to Padre Island to allow for the pipeline and booster pump(s).
- The pipeline channels are dredged by a 10-cy clamshell dredge with dump scows prior to each cycle of GIWW dredging and placed at the BIH ODMDS.
- It is assumed that the pipeline access channel will shoal back to its original condition prior to the next cycle of dredging.
- It is assumed that all rights-of-way will be obtained for placing the pipeline across Padre Island, thus no costs were included for this.
- It is assumed that culverts or pipeline tunnels will be provided to cross any streets or public ROWs on Padre Island, thus no costs were included for this.
- The pipeline will be buried in areas of beach access, but no costs were included for this.

2.12.7.6 Alternative 5C2: Hopper without Turning Basins in the LLM

- Alternative 5C2 assumes no turning basins are constructed for the hopper dredge.
- The hopper dredge will travel in a loop and dispose of the dredged material at the Port Mansfield ODMDS and the BIH ODMDS.

2.12.8 Dredged Material Management Plan Alternative

The DMMP estimates are based on the DMMP prepared by the USACE with the assistance of the ICT, summarized in Section 2.11 and provided in Appendix A. The DMMP represents the least environmentally damaging practical placement options for the different PAs and is based on the results of all previous studies that have been performed to date. The intent of the DMMP is to reduce impacts to seagrasses and also manage the sites for bird use, vegetation control, and recreational use. The dredging and placement varies among the PAs depending on the option in the DMMP.

Although the DMMP has placement recommendations for each PA, the cost estimates were performed on a Reach basis, utilizing the same assumptions as in the above estimates. This allowed a cost comparison with Alternatives 1–5 on an identical basis. The general assumptions listed at the beginning of the document apply to all estimates, including the DMMP estimates. All levees constructed for the DMMP are earthen levees built from on-site borrow material and utilize similar assumptions as Alternative 4.

2.12.9 Results

The final cost estimates developed for the USACE by Moffatt & Nichol are presented by each alternative described above in Table 2-35. As can be seen from an examination of Table 2-35, the cost per cubic yard ($/cy) ranges from $1.94 to $3.47 for the present practice. It should be noted that $3.47/cy for the present practice for Reach 5 is an artifact of the analysis by Reach and is not representative of actual costs for dredging Reach 5. This is because Reach 5 requires only infrequent maintenance and is always included with a contract that covers other portions of the Laguna Madre GIWW. However, the cost is representative of what would be expected if Reach 5 were maintained as a unit separate from the rest of the Laguna Madre GIWW, and since all alternatives were treated the same, it provides a good basis for comparison.

Offshore placement with a hopper dredge was the most expensive alternative with costs ranging from $25.21 to $38.50/cy. Offshore placement in general was several times current costs, ranging from $5.62/cy to the $38.50/cy noted above. Upland confined and upland thin layer were also relatively expensive, with $/cy costs ranging from $3.47 to $18.10. The DMMP costs range from $1.96 to $4.60/cy.

Table 2-35 also gives the ratio of the cost of each alternative to the present practice. As can be seen, the ratio for the DMMP costs range between 1.01 to 1.33 times current cost, whereas the ratios for offshore with a hopper dredge range from 2.90 to 18.83 times current costs.

TABLE 2-35

COST ESTIMATE FOR PLACEMENT ALTERNATIVES FOR THE GIWW,
PORT ISABEL TO CORPUS CHRISTI BAY

Alternative	Reach	Segment/PA	Dredging Method	Disposal Site	Unit Cost ($/CY)	Increase in Cost (Ratio) over Current Method
#1	1	1-3	Hydraulic	Current PA	$1.96	
#1	2	4-5	Hydraulic	Current PA	$2.19	
#1	3	6-9	Hydraulic	Current PA	$2.36	
#1	4	10-13	Hydraulic	Current PA	$2.04	
#1	5	14-15	Hydraulic	Current PA	$3.47	
#1	6	16-18	Hydraulic	Current PA	$1.94	
#2A1	6	16-18	Hopper	Offshore	$32.14	16.57
#2A2	6	16-18	Hopper	Offshore	$36.53	18.83
#2B1	6	16-18	Hydraulic-7 Scows	Offshore	$6.26	3.23
#2B1	6	16-18	Hydraulic-6 Scows	Offshore	$6.21	3.20
#2B1	6	16-18	Hydraulic-5 Scows	Offshore	$6.21	3.20
#2B1	6	16-18	Hydraulic-4 Scows	Offshore	$6.78	3.49
#2B1	6	16-18	Hydraulic-3 Scows	Offshore	$7.88	4.06
#2B1	6	16-18	Hydraulic-2 Scows	Offshore	$11.04	5.69
#2B2	6	16-18	Clamshell-3 Scows	Offshore	$5.62	2.90
#2B2	6	16-18	Clamshell-2 Scows	Offshore	$6.87	3.54
#2C	1	1	Hydraulic	Offshore (2 mi.)	$12.58	6.42
#2C	4	13	Hydraulic	Offshore (2 mi.)	$36.08	17.69
#2C	5	14-15	Hydraulic	Offshore (2 mi.)	$33.78	9.73
#2C	6	16-18	Hydraulic	Offshore (2 mi.)	$13.47	6.94
#3A	1	1-3	Hydraulic	Upland/Confined	$8.93	4.56
#3A	2	4-5	Hydraulic	Upland/Confined	$6.05	2.76
#3A	3	6-9	Hydraulic	Upland/Confined	$3.47	1.47
#3A	4	10-13	Hydraulic	Upland/Confined	$6.70	3.28
#3A	5	14-15	Hydraulic	Upland/Confined	$18.10	5.22
#3A	6	16-18	Hydraulic	Upland/Confined	$11.40	5.88
#3B	1	1-3	Hydraulic	Upland/ThinLayer	$10.45	5.33
#3B	2	4-5	Hydraulic	Upland/ThinLayer	$7.73	3.53
#3B	4	10-13	Hydraulic	Upland/ThinLayer	$8.70	4.26
#3B	5	14-15	Hydraulic	Upland/ThinLayer	$17.96	5.18
#3B	6	16-18	Hydraulic	Upland/ThinLayer	$13.39	6.90
#4A	1	1-3	Hydraulic	Current PA	$1.96	1.00
#4A	2	4-5	Hydraulic	Current PA	$2.19	1.00
#4A	4	10-13	Hydraulic	Current PA	$2.04	1.00
#4A	5	14-15	Hydraulic	Current PA	$3.47	1.00
#4A	6	16-18	Hydraulic	Current PA	$1.94	1.00
#4B	1	1-3	Hydraulic	Open-Bay/Confined	$5.62	2.87
#4B	2	4-5	Hydraulic	Open-Bay/Confined	$6.28	2.87
#4B	4	10-13	Hydraulic	Open-Bay/Confined	$8.18	4.01
#4B	5	14-15	Hydraulic	Open-Bay/Confined	$5.08	1.46

TABLE 2-35

COST ESTIMATE FOR PLACEMENT ALTERNATIVES FOR THE GIWW,
PORT ISABEL TO CORPUS CHRISTI BAY

Alternative	Reach	Segment/PA	Dredging Method	Disposal Site	Unit Cost ($/CY)	Increase in Cost (Ratio) over Current Method
#4B	6	16-18	Hydraulic	Open-Bay/Confined	$5.31	2.74
#4C	1	1-3	Hydraulic	Open-Bay/Semi-Confined	$3.39	1.73
#4C	2	4-5	Hydraulic	Open-Bay/Semi-Confined	$3.85	1.76
#4C	4	10-13	Hydraulic	Open-Bay/Semi-Confined	$5.47	2.68
#4C	5	14-15	Hydraulic	Open-Bay/Semi-Confined	$4.39	1.27
#4C	6	16-18	Hydraulic	Open-Bay/Semi-Confined	$3.12	1.61
#5A1-01	4	220-221	Hydraulic-4 Scows	Offshore	$7.34	3.60
#5A1-01	4	220-221	Hydraulic-3 Scows	Offshore	$7.98	3.91
#5A1-01	4	220-221	Hydraulic-2 Scows	Offshore	$8.43	4.13
#5A1-03	4	220-221	Clamshell-3 Scows	Offshore	$8.72	4.27
#5A1-03	4	220-221	Clamshell-2 Scows	Offshore	$7.77	3.81
#5A2	4	220-221	Hopper	Offshore	$25.21	12.36
#5A3	4	220-221	Hydraulic	Offshore (2 mi.)	$12.77	6.26
#5B1-01	6	233-234	Hydraulic-7 Scows	Offshore	$7.69	3.96
#5B1-01	6	233-234	Hydraulic-6 Scows	Offshore	$7.54	3.89
#5B1-01	6	233-234	Hydraulic-5 Scows	Offshore	$7.87	4.06
#5B1-01	6	233-234	Hydraulic-4 Scows	Offshore	$8.01	4.13
#5B1-01	6	233-234	Hydraulic-3 Scows	Offshore	$9.20	4.74
#5B1-01	6	233-234	Hydraulic-2 Scows	Offshore	$12.60	6.49
#5B1-02	6	233-234	Clamshell-4 Scows	Offshore	$7.46	3.85
#5B1-02	6	233-234	Clamshell-3 Scows	Offshore	$6.61	3.41
#5B1-02	6	233-234	Clamshell-2 Scows	Offshore	$7.77	4.01
#5B2	6	233-234	Hopper	Offshore	$31.53	16.25
#5B3	6	233-234	Hydraulic	Offshore (2 mi.)	$14.54	7.49
#5C1	4	10-13	Hopper	Offshore	$31.06	15.23
#5C1	5	14-15	Hopper	Offshore	$38.50	11.10
#5C1	6	16-18	Hopper	Offshore	$32.14	16.57
#5C2	5	14-15	Hopper	Offshore	$34.83	10.04
#5C2	6	16-18	Hopper	Offshore	$36.53	18.83
DMMP	1	1-3	Hydraulic	As per DMMP	$2.51	1.28
DMMP	2	4-5	Hydraulic	As per DMMP	$2.43	1.11
DMMP	3	6-9	Hydraulic	As per DMMP	$3.10	1.31
DMMP	4	10-13	Hydraulic	As per DMMP	$2.23	1.09
DMMP	5	14-15	Hydraulic	As per DMMP	$4.60	1.33
DMMP	6	16-18	Hydraulic	As per DMMP	$1.96	1.01

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